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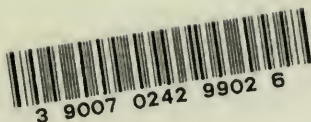
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Ontario Research Commission

FINAL REPORT

JANUARY
1948

PRINTED BY ORDER OF
THE LEGISLATIVE ASSEMBLY OF ONTARIO



TORONTO
PRINTED AND PUBLISHED BY BAPTIST JOHNSTON
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

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SESSIONAL PAPER No. 42, 1948



TORONTO

PRINTED AND PUBLISHED BY BAPTIST JOHNSTON
PRINTER TO THE KING'S MOST EXCELLENT MAJESTY

TO THE HON. RAY LAWSON, O.B.E.,

Lieutenant-Governor of the Province of Ontario.

MAY IT PLEASE YOUR HONOUR:

The undersigned has the honour to present to your Honour the Final Report of the Ontario Research Commission.

Respectfully submitted,

D. R. MICHENER,
Provincial Secretary.

Department of the Provincial Secretary.
January 6th, 1948.

January 6th, 1948.

THE HONOURABLE D. R. MICHENER,
Provincial Secretary,
Province of Ontario,
Parliament Bldgs.,
Toronto, Ont.

Dear Mr. Michener:

It is my privilege to transmit herewith the Final Report of the Ontario Research Commission pursuant to Order-in-Council dated August 28th, 1945.

In presenting this report I should like to express the appreciation of the Commission for the assistance they have received in the conduct of their work from the many groups with which they have been associated. They have received whole-hearted support from the members of the various Dominion and Provincial Government departments, the staffs of the universities, individuals and companies in the industrial field, the Canadian Manufacturers' Association and technical groups in Canada, the United States and Great Britain.

I have the honour to be, sir,

Your obedient servant,

ROBT. C. WALLACE,
Chairman.

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TERMS OF REFERENCE
ONTARIO
EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by the Honourable, the Lieutenant-Governor, dated the 28th day of August, A.D. 1945.

Upon the recommendation of the Honourable the Prime Minister, the Committee of Council advise that pursuant to the provisions of The Public Inquiries Act, R.S.O. 1937, chapter 19,

Dr. R. C. Wallace	Dr. R. K. Stratford	Dr. T. H. Hogg
E. Holt Gurney	Dr. G. I. Christie ¹	Dr. C. E. Burke, and
Dr. Sidney Smith	H. M. Turner	Dr. W. Sherwood Fox
W. E. Phillips	Dean C. R. Young	

be appointed commissioners to inquire into and report upon all matters concerned with scientific and industrial research as they affect the Province of Ontario and in particular to inquire into and report upon,

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario.

The Committee further advise that Dr. R. C. Wallace be appointed chairman of the Commission and that Professor J. O. Wilhelm be appointed Secretary of the Commission.

And the Committee further advise that the said Commissioners shall have the power to summon any person and require him to give evidence on oath, and to produce such documents and things as the commissioners deem requisite for the full investigation of the matters into which they are appointed to examine, by subpoena signed by the chairman or by any one of the commissioners hereby appointed.

Certified,

C. F. BULMER,
Clerk, Executive Council.

¹During a portion of the time Dr. G. I. Christie was unable to attend the Commission meetings on account of illness. Mr. W. R. Reek, President of the Ontario Agricultural College, acted in his place.

ONTARIO
EXECUTIVE COUNCIL OFFICE

Copy of an Order-in-Council approved by The Honourable the Lieutenant-Governor, dated the 23rd day of July, A.D. 1946.

The Committee of Council have had under consideration the report of the Honourable the Provincial Secretary, dated July 18th, 1946, wherein he states that,—

WHEREAS, under the provisions of The Public Inquiries Act, a Commission under the Great Seal bearing date the twenty-eighth day of August, 1945, appointed Dr. R. C. Wallace et al to inquire into and report upon

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario;

AND WHEREAS it is deemed expedient that E. T. STERNE of the City of Brantford should be associated in the said inquiry;

The Honourable the Provincial Secretary therefore recommends that, pursuant to the provisions of the said The Public Inquiries Act, the said E. T. STERNE be appointed a Commissioner for the purposes in the aforesaid Commission contained and recited to be associated for that purpose with the Commissioners therein named, fully and effectually giving and granting unto the said E. T. Sterne all and every the like powers given and granted by the said Commission to the said Commissioners as if the said E. T. Sterne had been appointed by the Commission aforesaid.

The Committee of Council concur in the recommendation of the Honourable the Provincial Secretary, and advise that the same be acted upon.

Certified,

C. F. BULMER,
Clerk, Executive Council.

ONTARIO RESEARCH COMMISSION

GENERAL STATEMENT

On December 4, 1946 the Ontario Research Commission submitted to the Provincial Secretary a report of progress¹. Since this was purposely made a full and comprehensive statement of the field to be reviewed, of the problems discovered and of the Commission's treatment of these problems, it is possible to cast the Final Report, which is submitted herewith, in briefer and more summary form.

1. THE TASK

The task assigned to this Commission is set forth in the terms of reference of an Order-in-Council dated August 28, 1945. This is

“... to inquire into and report upon all matters concerned with scientific and industrial research as they affect the Province of Ontario and in particular to inquire into and report upon,

- (a) any matter relating to the utilizing of scientific personnel and scientific facilities;
- (b) any application or request to the Government of Ontario for financial support for any project within the field of industrial and scientific research;
- (c) the co-ordination of the activities of existing and prospective research units which are supported in whole or in part by public funds; and
- (d) the integration of research activities within the Province of Ontario with research activities outside the Province of Ontario.”

2. THE COMMISSION'S INTERPRETATION OF THE GOVERNMENT'S INSTRUCTIONS

The Commission conceives it to be its primary duty to convey to the Government its interpretations of the terms of reference just quoted by which the Commission has been guided.

Definition of Research

In order that the Government and the Commission may be sure that they are speaking about the same things, they must employ the same terms and definitions. One cannot do better than to adapt, with a few changes, to the situation in Ontario the classification and description of research under the headings of Pure or Fundamental Research, Background Research, and Applied or Practical Research, set forth in a report² recently published in Ottawa.

¹Interim Report, Sessional Paper No. 47, 1947.

²Research and Scientific Activity, Canadian Federal Expenditures—1938-1946, Page 11. See Appendix XII.

General Program

In the first place, the Commission understands that it does not lie within its province to consider the technical problems involved in the detailed planning and conduct of the research efforts encouraged by the Commission. The Commission is concerned, rather, to provide the Government with a program of research which is based upon the best scientific advice available in Canada or elsewhere, and to make certain that this program can be applied directly to the formulation and execution of Government policy. The Commission is also concerned **to recommend to the Government a plan of organization of research which is designed to ensure that the scope and balance of the program are such as will direct the application of scientific knowledge and effort into those fields which offer the brightest promise of yielding returns of permanent value to the Province, that the funds made available are adequate and proportionate to needs, and that such funds are used to the best advantage.**

The report which the Commission submits herewith is to be regarded as "final" only in the sense that it is the final report of this Commission as such. The entire experience of the Commission leads it to share fully, in reference to Ontario, the view recently expressed in Great Britain by a highly competent authority on research:¹ ". . . It is too early to decide what the ideal Government organization for research should be. The organization for fostering scientific research must remain for many years in a state of active development." Consequently, it would be most harmful to the public interest to regard this report as ideal, since manifestly the suggested program will of necessity be subject to a process of evolution.

3. WHAT THE COMMISSION HAS ACCOMPLISHED

(a) **General Statement.** The experience of the Commission and what it has accomplished up to the present constitute a basis on which are built the recommendations the Commission submits in this report. The facts involved are set forth here at first in a general statement.

1. In the early months of its service the Commission succeeded in bringing together most of the leading workers in each field of scientific research in Ontario. This is the first time in the history of the Province that this result has been achieved.
2. Through the numerous conferences that ensued between the Commission and the scientific workers the Commission was able to initiate an active and practical system of co-ordination of effort in and among the several fields of research in the Province.
3. One result of these conferences was that they supplied the Commission with materials out of which the Commission constructed in a number of fields programs of research which were undertaken immediately: in some fields these programs consist of extension of investigations already under way and in others of entirely new endeavours. This work during the fiscal year '47-'48 will involve expenditures in the various research fields of approximately

¹Government Research and Development in Great Britain—Nature, Sept. 20, 1947, page 379; Sir Edward Appleton, British Commonwealth Scientific Conference, London, 1946, Report of Proceedings, Cmd. 6970, page 15.

\$300,000.00. The work is under competent direction of research workers in the universities and the Ontario Research Foundation.

4. The diverse experiences and observations of the Commission have afforded the material required as a foundation on which the Commission can now construct a continuing permanent plan for the organization of research effort in Ontario, a plan which the Commission can confidently recommend to the Government as promising to achieve the purpose set forth previously in this report.¹

5. From the outset the Commission studied with care the existing and prospective facilities for the training of research workers in order to ascertain whether they were adequate to meet the needs. In the light of the limitations revealed by the study the Commission, even in its first year of service, recommended the establishment of a system of fellowships as the first and indispensable step towards providing for the training of a competent personnel. During the present academic year the Government provided an appropriation of \$50,000.00. 58 students have been assisted by scholarships to a total of \$44,275.00. The profitable experience afforded by the operation of this system has prompted the Commission to recommend it as a necessary instrument of permanent policy.

(b) **Expanded Statement.** The obvious first step of the Commission was to determine the several fields of scientific research with which the Province is concerned. The Commission has held twenty-two meetings, some of which extended over three days. Individual members of the Commission in addition have attended meetings of the Advisory Committees and on occasion have acted as Chairmen to them in the preliminary stages of their organization. The personnel of the Advisory Committees is given in the Appendices. The administrative office at 43 Queen's Park has been the centre for almost daily informal meetings of research men. Special efforts were made to keep visiting scientists in touch with the activities of the Commission by arranging visits and conferences.

Various Fields of Research

A careful survey revealed that the fields which stand out with marked individuality are:

- Agriculture
- Fisheries and Wildlife
- Forestry (Production and Utilization)
- Industry (both large and small)
- Mines, Minerals and Metallurgy
- Soils
- Highways²
- Industrial Wastes²
- Aerial Surveys.²

¹See Page 2, supra.

²These are of a more general character in that they overlap in some degree upon one or more other fields.

Committees and their Work

In order to secure the fullest possible amount of authoritative data upon research in all these fields, the Commission has instituted in each field a Committee composed of persons who are best acquainted with that field. Since a Committee includes, in addition to workers in scientific research, representatives of both federal and provincial departments charged with the administration of natural resources, as well as representatives of interested industries, the Commission is convinced that the representation thus provided is satisfactorily comprehensive. For the guidance of each Committee its function has been clearly outlined by the Commission:

- (a) to survey its specific field thoroughly;
- (b) to report to this Commission such facts as it may find regarding the status of the research in that field, and, further, to report upon the existing facilities and trained personnel required;
- (c) to recommend the means for applying scientific knowledge.

By means of this division of duties among the several Committees the Commission has been able to attain two results of primary importance:

- (a) a manageable co-ordination of the great volume of diverse material submitted by the Committees;
- (b) a clear conspectus of the real problem and of the active program required in the whole territory of research in Ontario.

The Main Advisory Committees have held approximately 40 meetings, the Sub-Committees 20, and Executive Committees held 17 meetings. Most of the meetings were held in Toronto but some were held in other places in the Province which are of special interest to the particular committee concerned. This permitted discussion of local problems, since interested scientists in the area were invited to sit with the Committees.

The research activities under the Committees are too numerous to list or to describe here, but a few examples outlined briefly will indicate the way in which the committee system functions.

1. The Committee on Mines, Minerals and Metallurgy set up a sub-committee to investigate the problem of mine cable or wire rope. This sub-committee with the co-operation of the Ontario Research Foundation has begun work, is preparing a general bibliography and is fabricating a variety of different ropes under controlled conditions. These ropes will be put into service and accurately observed during their period of use. Concurrently, apparatus is being constructed which will test ropes in the laboratory under plant conditions.

2. Another problem of the same Committee has to do with the production of sponge iron from Ontario ores. As a step in the investigation, fifty-five tons of Steep Rock ore was sent to Sweden and put through a Wiberg furnace. A report on the progress of this work is being prepared.

3. The Committee on Fisheries and Wildlife has initiated an important and comprehensive program on Lake Erie. The program comprises a study of (1) chemical conditions of the water in regard to oxygen, carbon dioxide,

acidity, alkalinity, silica, nitrogen and phosphorus content; (2) physical conditions of the water in regard to temperature gradients and light penetration; (3) microscopic plant and animal populations; (4) the nature of the lake bottom; and (5) the spawning and early growth of the commercially valuable fish.

Scholarships

The system of scholarships instituted by the Government of the Province and administered by the Commission has already proved its worth and should be continued. It enabled the Commission even in the first year of its existence to assist many promising students and to inaugurate several very important research projects. As the system continues to function the numbers and quality of skilled scientists will be rapidly enhanced.

In 1947 fifty-eight scholarships have been provided amounting in all to a value of \$44,275.00. The students are at all stages of their graduate courses and the distribution among subjects and the universities is shown in Appendix X.

Economics and Statistics

From the outset the Commission has conferred frequently with the Ontario Bureau of Statistics and Research and with the Economic Research Branch of the Department of Reconstruction in Ottawa. This association has been of great value in revealing the intimate connection that often exists between scientific research and economic research, and has emphasized the fact that frequently it is advisable to make an economic survey before undertaking a research.

4. RECOMMENDATIONS

Your Commission recognizes that decisions on matters of general policy concerning scientific and industrial research must remain a function of Government, such decisions to be reached through the medium of a Cabinet Committee or through such other means as the Government may find most appropriate. Your Commission respectfully submits the recommendations which follow:

**Permanent
Advisory
Council**

- (a) That a permanent Commission or Advisory Council¹ be set up to continue to guide the research activities of the Province in such a way as to take advantage of the organization and undertakings already instituted by the present Commission.

The Commission conceives the chief functions of the Council to be:

**Advise
Government
as to relative
needs for aid**

1. to advise the Government as to the financial aid required to carry out each successive annual program of research; also to correlate all research projects supported by the Government with a view to ensuring that the amount of research devoted to the various kinds of the Province's natural resources and the moneys appropriated therefor be distributed in just proportion among them;

**Welcome advice
from all sources**

2. to receive and weigh representations from any authoritative source within the Province concerning the needs of research in all fields;

**Advise various
interests as to
best means of
investigation**

3. to advise the Government as well as industrial and other interests, according to the needs of either or of both, in their selection of the most satisfactory means of undertaking specific research projects;

**Research
information**

4. to institute some form of service, either independently or in co-operation with other agencies, as the Council may deem best, to promote the distribution of information concerning research and its results, especially information pertinent to the various interests of Ontario; and also to assist in the preparation and publication of appraisals of scientific information not available through the usual channels.

**To encourage
co-operation
between
Government
and Industry**

5. to institute some form of co-operative research in which industry and the Government participate in financial support in some such form as obtains in the Industrial Research Associations of Great Britain;

¹The proposed permanent or Advisory Council will from this point onwards be referred to as the Council.

Scholarships

6. to assist, through the maintenance of a system of scholarships and other approved means, in providing, on an increasing scale proportionate to requirements, for the training of a competent research personnel;

Reports

7. (i) to provide the Government periodically with comprehensive reports which set forth clearly the progress of the research activities within the Province;

(ii) to encourage the publication, chiefly for the information of the general public, of sober factual statements, cast in non-technical, readable language, of the research activities sponsored by the Council, the purpose of such publications being to preclude unwarranted expectations of greater and speedier results than can be justified.

Committees in all fields of research

(b) That in each major field of research there be instituted a Committee composed of representatives of all important divisions of the field, the function of the Committee being to assist the Council in the discharge of its functions by:

1. maintaining a continuous survey of the needs and developments in its field;

2. keeping the Council informed concerning the findings of the surveys;

3. reporting to the Council the Committee's judgment as to allocation of approved research projects, and also as to estimates of the amounts of money required to support them all and severally;

4. assisting in assembling, analysing and interpreting information relating to the field of each Committee's particular competence.

Statutory grants (c) Finances.

1. That the Government assure the Council of the provision each year of a minimum statutory grant of funds; this is required to meet the expenses of:

(i) the full time executive office of the Council and the Committees;

(ii) the expenses of the Council and the Committees;

(iii) maintaining annual scholarships, and special "grants-in-aid";

(iv) securing the uninterrupted support of long-term research projects not otherwise provided for;

- (v) such service or services as may be set up to provide for the publication of reports and the distribution of information regarding research.

Annual appropriations

2. The Commission regards it as obvious that annual grants, some appropriated expressly to meet the cost of short-term projects, and others to enable the Council to respond promptly to emergent situations in reference to research, will also be required.

Responsibility for administration of finance

3. The Commission holds the view that the administration of the finances involved in the support of programs recommended by the Council is logically the function of a Department of Government and not of the Council.

Special nature of research

As the Commission proceeded in its investigations it became more and more aware that the unique nature of true research is a factor that must always be borne in mind if the object of research is not to be imperilled. Research is veritably a "sensitive plant" in the realm of higher human endeavours. Hence, the strict application of a rigid administrative system to some kinds of research work may, through creating an atmosphere inimical to the conduct of research, cause great waste of time, money and effort. Flexibility should be allowed to the degree that affords the greatest freedom compatible with safety. Flexibility is important in securing the right man for the right job and in the financial control of the project which has been entrusted to him. The Commission hopes that the Council whom the Government may appoint to succeed the Commission will make provision to review the situation periodically in order that such freedom and flexibility are maintained as a practice.

5. GENERAL OBSERVATIONS ON GOVERNMENT AND INDUSTRIAL RESEARCH AS APPLIED TO ONTARIO

Provincial Government has a responsibility for research

In the light of its long and comprehensive survey of the conditions obtaining in regard to scientific research the Commission clearly sees the reasons why the responsibility for supporting a large program of research rests upon the Government of Ontario.

1. In the first place, Canada is too large a country to warrant it entrusting the whole program of scientific research solely to one organization.
2. The more modest proportions of the Province offer the conditions that promise more rapid progress in certain kinds of research. The control over the natural resources of the Province are a constitutional responsibility of the Province. Research into better methods of improving and utilizing the natural resources is also a provincial responsibility.

3. Ontario is the largest and most highly industrialized of the provinces; by reason of her distinctive geographical situation and the vast variety of her resources, she has a large number of research problems that are peculiarly her own.

The Commission, therefore, holds it to be a normal function of the Government of the Province to take a leading part in promoting, co-ordinating and supporting financially an extensive program of approved effort in this broad realm. The program covers many fields which, though lightly overlapping upon each other in some instances, are nevertheless to be regarded for practical purposes as separate. The measure of the responsibility of government in each field should logically be deduced from the measure of the importance of each field, both absolutely and relatively, in the economic and other interests of the people.

Dominion-Provincial Division of Funds

In order that expenditures for research be allocated in proper proportion as between the Dominion Government and the Provincial Government, it is imperative that an active liaison be maintained between the two governments. The Commission is of the opinion that if the most effective benefits from research are to be assured, each research unit should be close to the ultimate beneficiary. In order to make sure that the highest degree of co-ordination obtains between the two governmental agencies it will be necessary in the case of each project to determine carefully at the outset and to re-examine frequently thereafter the division of responsibility for conducting the investigation concerned and for the provision of the funds supporting it. It is a matter for profound regret that at present statistics on governmental expenditures for research are very indefinite and are compiled on a diversity of bases. Hence they do not permit one to make more than very general statements on their authority, nor even to make comparisons among them that have any meaning of value. As prevailing vaguenesses are abated, in like proportion will the division of responsibility for conducting and financing certain kinds of research become more sharply defined.

Proportion of Government Aid

The amount of financial aid for research provided by all agencies, including the Government of the Province, and, hence, the sum of the research efforts made possible by this aid, fall very far short of meeting the host of existing needs.

The deficiencies in research facilities and activities in Ontario which the Commission has found in its survey are thrown into high relief when compared with the statistics in regard to research under other governmental jurisdictions. It is not possible to arrive at a fair comparison. Some figures quoted are: 8/10 of 1% of national income in Britain, 1% projected in U.S.A. and an estimated 1% in Russia. In agriculture in Ontario with a productive value of more than \$400,000,000.00 only \$300,000.00 is being spent on research this year.¹

¹See Appendix XI.

No unnecessary duplication

The Commission has found through the activities of the Committees that there is no wasteful duplication of research.

One must not assume, however, that there should never be any duplication of research effort. On the contrary, certain special problems may arise in the investigation of which positive advantage may be gained if several workers are undertaking concurrent research directed to the same end. The inevitable differences among the workers in regard to points of view, knowledge, experience and technique, would promise a more exacting testing of methods and results, and, possibly, also hasten the attainment of objectives.

Personnel

The supply of trained personnel is far below the number needed to carry on the program of research for which financial support is available even now.

That the existence of a sufficiently large and highly trained staff is the prime prerequisite to carrying out successfully a worth-while program of research is patent to everybody. There are occasions when improvised physical facilities may serve satisfactorily but only when at the same time there is the trained staff to direct the improvising. But personnel can never be improvised, since there is no substitute whatever for the highest type of skill and training involved. It is of the utmost importance not only that the number of scientists be adequate but also that they be distributed among the several fields of research in proportion to the relative needs of these fields. It will be one of the duties of the Council to determine at the outset the nature and extent of all physical facilities required, and the numbers and composition of the personnel needed to carry out the programs of research outlined. This will enable the Province to maintain material and personnel at proper levels.

Universities chief training school of personnel

The duty of providing a trained research personnel rests chiefly with the universities. The Commission is fully aware that it is without authority to recommend financial expenditures other than those required for the support of research. Nevertheless, it believes it to be its duty to call attention to the existence of an unavoidable combination of factors, one of them being outside the Commission's purview, upon whose internal balance hinges the success or failure of any large scale program of research. These are, in order of importance and timing: the universities, the research force, the investigation, the results. These are like a row of children's building blocks: if the first falls, all the others fall in sequence. If the universities are without sufficient means to train increasing numbers of research workers, the force will be hampered, research will languish, results will be scanty and disappointing, because Ontario will be unable to keep her position in relation to the rest of the world.

Government department training

The policy of offering to university graduates and undergraduates summer employment under departments of government in activities involving actual research endeavour affords sound practical training in certain fields.

At present the influences that have the greatest effect in retarding enlistment in the ranks of research workers in Ontario are two: (a) uncertainty as to the probability of finding enough openings for employment in Canada in the fields in which the candidates are trained; (b) the glaring fact that at the same level of employment and of the workers' scientific training the scale of salaries in Canada is lower than that obtaining in the United States. This adverse effect would be appreciably offset if the Government would soon adopt a general policy of expanding the employment of scientists.

Distribution of technical information

A great part of scientific knowledge which has resulted from research would be of great value to the Province if it could be more fully utilized.

It would seem to be a duty of the Council to devise and progressively to evolve some systematic means whereby such scientific knowledge can be made more readily available than it now is for those to whom it may be of benefit. True, Canadian scientific and technical workers are not entirely without sources of this kind of information; for example, the Technical Information Service of the National Research Council, the research services of the Ontario Research Foundation, the libraries of universities, industries, scientific institutes and a number of co-operative associations. But useful as these are, they are not as useful as they would be if there existed some medium designed to co-ordinate all avenues of access to their combined resources and the resources of all other services. The need is great and the task of meeting it is difficult, though, if the problem is studied thoroughly, not impossible.

Natural resources

All the investigations undertaken by the Commission have without exception led the Commission to the unqualified conviction that a greatly increased financial support of research on the part of the Government is imperative. In certain fields—Forestry, Fisheries and Wildlife, Soils, Mining and Agriculture—this is especially obvious because of the deplorable and widespread economic effects caused by an excessively rapid consumption and destruction of natural resources in these fields.

The fact that the Governments of Great Britain and the United States are vastly increasing their expenditures for research in the field of natural resources is ample proof of their conviction that research is a vital necessity if their resources are to be adequately developed.

Industry

A large number of the big industries have long been operating extensive research laboratories of their own and are steadily increasing their annual appropriations for that purpose. This fact the Commission regards as the most convincing single proof that profit can be derived from scientific research.

Small industries

A very real problem lies with the small industries. Many of them are unaware of the import of scientific research; to many the idea has never occurred that science has any practical bearing upon their businesses; many

firms are so small that they are unable either to set up laboratory research facilities of their own or to support fellowships in a public research institute.¹ Such firms are without defence against the penalties that result from obsolete processes and products. It is as much the duty of government to aid in providing the needed defence for small industries and their dependent communities as it is in other fields. However, the method of providing aid of this type is different, difficult and slow, as it was at one time in Great Britain. The Commission is fully persuaded that the same kind of result that has been achieved in Great Britain can be achieved here through the co-operative effort of industry and government.

The Commission in its Interim Report recommended that the facilities of the Ontario Research Foundation be expanded to include an industrial advisory service. With the co-operation of the Canadian Manufacturers' Association, the Trade and Industry Branch of the Department of Planning and Development and the Ontario Research Foundation, it was possible to begin this service in July of 1947 under the title, Ontario Industrial Research Service.

The Industrial Research Committee of the Commission is planning, in addition, a program designed to promote a greater measure of co-operation within individual industrial fields with a view to the solution of the problems common to each field. This program is receiving the energetic support of the Canadian Manufacturers' Association, the Department of Planning and Development and the Ontario Research Foundation.

Ontario Research Foundation

The industrial economy of the Province requires an ever increasing application of science to its operations. The demands for scientific assistance are greater even than in wartime. The Ontario Research Foundation is gearing itself to serve a broader field and needs adequate financial support on that account.

Government contribution to research

In this report the Commission includes a program of research in each field which the Commission believes it profitable to undertake². Every project in these programs has been selected in the light at once of general needs and relative urgency. The Commission is fully aware that the adoption of the recommendations to support research programs of the scale and scope described and at the same time to provide for the training of an ever increasing force of skilled personnel, will commit the Province to a progressive annual expenditure under the title of research which will greatly exceed that made in any past year. The ripest reflection can lead only to the conclusion that if the Province is determined to make the best possible use of its resources and sees clearly that organized research supported by the Government is the only known avenue leading directly to that end, the Province cannot avoid assuming the obligation. It is the price that must be paid for the enhancement of the people's welfare and prosperity through the proper use of our Province's natural heritage of potential wealth.

¹See Annual Report of the Ontario Research Foundation, 1945, page 7.

²See Appendix I-IX.

But what assurance has one that there will be worth-while return from the investment which the Commission counsels the Province of Ontario to make in research? Happily, one can offer a positive and most encouraging assurance, an assurance drawn direct from the Allied Nations' experiences in war. So great is Britain's confidence in it that even in this time of economic distress she boldly supports her research program for this year by voting an unprecedented appropriation—£67,000,000 on general account and, in addition, £11,000,000 for research in the universities. The reason for Britain's exemplary faith in research is set forth clearly in a statement made a year ago by Sir Edward Appleton, Secretary of the British Government's Department of Scientific and Industrial Research; it may be quoted here with eminent appropriateness:¹

“The speed at which development was carried through in wartime made it easy to trace cause and effect, and to see how the final product was related to the efforts of the research worker. The public has thus had a complete demonstration of what science—variously applied—can achieve, and has come to realise what it may expect from science in peacetime. Accordingly the public wants to be assured that the facilities and resources in this country both for fundamental and applied research are adequate, that industry is ready to use the results of research, and that the intimate and fruitful collaboration between science and industry established in the war will be continued.”

¹Industrial Research, 1946, Todd Publishing Company Limited, London and New York, p. 33.

APPENDIX I.

FISHERIES AND WILDLIFE

Committee:

Prof. J. R. Dymond (Chairman).....	Royal Ontario Museum of Zoology.
Dr. A. M. Fallis (Secretary).....	Ontario Research Foundation.
Prof. C. E. Atwood.....	Zoology, University of Toronto.
Dr. A. O. Blackhurst.....	Ontario Federation of Commercial Fishermen.
Dr. C. H. D. Clarke.....	Ontario Dept. of Lands and Forests.
Prof. A. F. Coventry.....	Zoology, University of Toronto.
Mr. E. C. Cross.....	Royal Ontario Museum of Zoology.
Dr. H. W. Curran.....	Biology, Queen's University.
Dr. F. E. J. Fry.....	Zoology, University of Toronto.
Dr. W. J. K. Harkness.....	Ontario Dept. of Lands and Forests.
Mr. L. Hughes.....	Ontario Tourist Trade Association.
Prof. F. P. Ide.....	Zoology, University of Toronto.
Dr. W. H. Johnson.....	Zoology, University of Western Ontario.
(Substitute: Dr. H. Battle).....	Zoology, University of Western Ontario.
Dr. R. R. Langford.....	Zoology, University of Toronto.
Mr. H. H. MacKay.....	Ontario Dept. of Lands and Forests.
Mr. K. M. Mayall.....	Ontario Dept. of Planning and Development.
Mr. Tom C. McCall.....	Ontario Dept. of Travel and Publicity.
Mr. W. Austin Peters.....	Ontario Federation of Anglers and Hunters.
Dr. N. W. Radforth.....	Botany, McMaster University.
Mr. Lester L. Snyder.....	Royal Ontario Museum of Zoology.
Dr. A. Emerson Warren.....	Zoology, McMaster University.
Prof. J. O. Wilhelm.....	Ontario Research Commission.

Meetings:

November 10th, 1945.....	Ontario Research Foundation, Toronto.
December 1st, 1945.....	Ontario Research Foundation, Toronto.
April 6th, 1946.....	Parliament Buildings, Toronto.
August 19th, 1946.....	Queen's University Biological Station, Chaffey's Locks.
October 4th, 1946.....	Royal Ontario Museum of Zoology, Toronto.
November 9th, 1946.....	Royal Ontario Museum of Zoology, Toronto.
March 22nd, 1947.....	Royal Ontario Museum of Zoology, Toronto.
October 4th, 1947.....	Royal Ontario Museum of Zoology, Toronto.
November 29th, 1947.....	Royal Ontario Museum of Zoology, Toronto.

Sub-Committees:

Technical Session, 1948

- Dr. F. E. J. Fry (Chairman).....Zoology, University of Toronto.
Dr. A. M. Fallis.....Ontario Research Foundation.
Mr. C. David Fowle.....Zoology, University of Toronto.
Dr. A. B. James.....Toronto East General and Orthopaedic
Hospital.
Dr. A. Emerson Warren.....Zoology, McMaster University.

Publicity

- Mr. E. C. Cross (Chairman).....Royal Ontario Museum of Zoology.
Dr. A. O. Blackhurst.....Ontario Federation of Commercial
Fishermen.
Mr. L. Hughes.....Northern Ontario Outfitters' Associa-
tion.
Prof. F. P. Ide.....Zoology, University of Toronto.
Dr. W. H. Johnson.....Zoology, University of Western
Ontario.
Mr. K. M. Mayall.....Ontario Dept. of Planning and De-
velopment.
Mr. L. L. Snyder.....Royal Ontario Museum of Zoology.

FISHERIES AND WILDLIFE RESEARCH IN ONTARIO

General Position in the Economy of Ontario

Ontario's fisheries and wildlife are two resources which, while at present in the category of "wasting" resources, could be maintained at a reasonably permanent level. That they are important resources is generally accepted. It could not be otherwise, since ninety per cent of the Province is blessed with one or both of them, and fifty per cent of the Province will produce no other crop than they now produce. They provide a direct annual income of some five million dollars a year to commercial fishermen and trappers, who are the primary producers for a number of secondary industries. They provide the chief attractions for the host of tourists who spend in the Province an estimated hundred million dollars a year, an expenditure which makes possible the employment of a number of people in direct service, and which is the main support for the industries engaged in the manufacture of sporting equipment. Thus they represent an abundant source of exports, provided we realize that Nature's beneficence is not unlimited, and that our privilege of exploiting these tremendous gifts involves the duty of conserving them. Aside, too, from purely monetary considerations is the fact that they afford to many of our own citizens excellent facilities for recreation, a matter of considerable importance to general welfare.

Government Responsibility

The maintenance of these resources is, of course, left almost entirely to the Government. Since their nature is such that they are exploited for pleasure or for profit by thousands of individuals, no private groups or corporations are in a position to assume as much responsibility as they would where exploita-

tion by a few might be directed by commercial common sense, with a view to permanence. Then, too, since the Government derives directly from these resources a large revenue—approximately a million dollars a year—it should be responsible for the proper husbanding of them.

Present Methods of Conservation

That that responsibility has been accepted is borne out by the efforts of the Government to protect both fisheries and wildlife. There have been legal restrictions on the lengths of the hunting and fishing seasons, on the size and the number of the fish taken, and on the number of birds or animals shot. There has been complete protection for some species and there has been considerable re-stocking of game fish and birds. These efforts have modified the effects of too rapid “mining” of these two great resources, but yet are quite inadequate to provide a complete solution to the problem of constant depletion. They are inadequate, not because they are in themselves useless, but because other factors in the environmental factors of fish and wildlife—settlement, cultivation of the soil, deforestation, construction and destruction of dams, and the pollution of water with sewage and industrial wastes—may be detrimental to the purpose motivating our present efforts. These other factors cannot be ignored and any comprehensive long-term program aimed at correcting the basic causes of depletion must be based on adequate knowledge of all the favourable and unfavourable factors.

Present Situation

To date biological research is wholly inadequate to provide the information necessary for the proper administration of Ontario's fisheries and wildlife resources. As a matter of fact, aside from the collection of valuable data made by the Royal Ontario Museum of Zoology over a period of years, there has been no systematic investigation of terrestrial wildlife in the Province. As a result our legislation and our practices have been based more on opinion than on scientific knowledge. The present bounty on “wolves” may be defeating its real purpose—that of deer protection, and it is not unlikely that agriculture may be paying a considerable penalty for our constant warfare against hawks, owls, skunks, weasels and foxes. Even the lowly forest mouse may provide an administrative riddle, for, while it is known to occupy a prominent place in the diet of our fur bearing animals, its depredations may be deterring forest regeneration or may equally well be controlling some insect pests by eating their larvae.

While fisheries research is in a much happier position, historically, it is still too woefully inadequate to justify much confidence. We are still without reliable data concerning the capacity of waters to maintain a stock of fish, as regards either population or species, and we are without complete information regarding many important environmental factors for all species.

The Requirements

While there are sufficient organizations to undertake an adequate program of research, they are, at least in the cases of the universities and the Ontario Research Foundation, badly handicapped by limited and obsolete facilities as well as by a shortage of personnel. To a large extent research on fisheries

and wildlife has had to be relegated to a position of minor importance, to an uncertain and disjointed existence, with recurrent revivals when space, time, and money permitted. In such circumstances there can be little doubt that much of the value of the work accomplished was lost.

The immediate needs may be summarized as follows:

1. Provision of Personnel:

- (a) The establishment of scholarships with a view to encouraging graduate work in the field of fisheries and wildlife.
- (b) The institution of a policy of employment preference for scientifically trained personnel in the administration of these resources to offer further encouragement to students in these fields.
- (c) The institution of a policy of employment preference for undergraduates in these fields in temporary summer appointments for purposes of administration.

2. Extension of Facilities and Staff:

- (a) Queen's University—Further extension of the laboratory at Lake Opinicon and future extensions to cover work in Lake Ontario.
Research personnel.
- (b) University of Western Ontario—Extension of present program in Lake Erie.
Research personnel.
- (c) McMaster University—Additional facilities for investigations on the Dundas marshes and Lake Ontario.
Research personnel.
- (d) University of Toronto—Laboratory with space far beyond what exists at present.
Research personnel.
- (e) Departments—Additional facilities and personnel in the Provincial Parks and River Development Areas and extension of projects contemplated.
- (f) Ontario Fisheries Research Laboratory.
Research personnel.
- (g) Ontario Research Foundation—Extension to other fields than Parasitology.
- (h) Royal Ontario Museum of Zoology.
Additional staff.

RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
MCMMASTER UNIVERSITY 1. The Ecology of the Muskrat in the Dundas Marsh and Surrounding Territory. (A. E. Warren).	McMaster; Royal Botanical Gardens; Dept. of Lands and Forests; Hamilton Angling and Hunting Assn.; Royal Ontario Museum.	\$ 450.00	\$ 1,645.00	\$ 2,095.00
2. Limnological Investigation of the Dundas Marsh and Adjoining Waters. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ontario Fisheries Research Laboratory; Hamilton Dept. of Health.	298.00	1,665.00	1,963.00
3. An Ecological Survey of the Birds of Wentworth County, with particular reference to Water-Fowl. (A. E. Warren).	McMaster; Royal Botanical Gardens; Hamilton Angling and Hunting Assn.; Hamilton Nature Club; The Federation of Ontario Naturalists; Dept. of Lands and Forests; Dept. of Mines and Resources; Royal Ontario Museum of Zoology.	430.00	965.00	1,395.00
4. The Ecology of the Fishes in the Dundas Marsh. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ontario Fisheries Research Laboratory; Ont. Dept. of Lands and Forests; Hamilton Angling and Hunting Assn.; Hamilton Harbour Commission; Royal Ontario Museum of Zoology.	492.00	1,965.00	2,457.00
5. The Mosquito Problem and its Biological Control. (A. E. Warren).	McMaster; Royal Botanical Gardens; Ont. Dept. of Lands and Forests; Hamilton Dept. of Health; The Desplaines Valley Mosquito Abatement District, Lyons, Illinois.	650.00	1,790.00	2,440.00
6. Life History of the Carp. (A. E. Warren).	McMaster; Royal Botanical Gardens; Dept. of Lands and Forests; Ontario Fisheries Research Laboratory; Royal Ontario Museum of Zoology.	310.00	805.00	1,115.00
7. Study of Aquatic Insects of the Dundas Marsh.	McMaster; Royal Botanical Gardens.	357.00	1,795.00	2,152.00
8. The Mammalian Fauna of Wentworth County. (A. E. Warren; L. A. Prince; H. Eydt; M. Inksetter).	McMaster; Royal Botanical Gardens; Hamilton Angling and Hunting Assn.; The Hamilton Nature Club; Offices of the County Clerk and Local Townships; Royal Ontario Museum of Zoology.	350.00	2,335.00	2,685.00
Forward.....		\$3,337.00	\$12,965.00	\$16,302.00

RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
McMASTER UNIVERSITY—(Cont'd.)				
Director's travel and other expenses.	Brought Forward.....	\$3,337.00	\$12,965.00	\$16,302.00
Library Purchases.	.....		200.00	200.00
9. Ecological Investigations on Soil Micro-organisms. (J. J. Miller; N. W. Radforth).	.....	100.00		100.00
	McMaster; Royal Botanical Gardens.	500.00	2,000.00	2,500.00
10. Soil Resources in Relation to Micro-floral Studies. (N. W. Radforth; L. Laking).	McMaster; Royal Botanical Gardens.	100.00	600.00	700.00
11. Floristic Survey of the Eastern Portion of the North Shore of Lake Erie, including Rondeau Park and Turkey Point. (N. W. Radforth; L. O. Gaiser).	McMaster.	500.00	3,200.00	3,700.00
12. Taxonomic and Ecological Survey of Plant Life in Cootes' Paradise Area of Royal Botanical Gardens. (N. W. Radforth).	McMaster; Royal Botanical Gardens.	500.00	1,200.00	1,700.00
QUEEN'S UNIVERSITY BIOLOGICAL STATION				
13. Migration, Rate of Growth and Population Studies on the Bass. (H. W. Curran).	Queen's University.	\$5,037.00	\$20,165.00	\$25,202.00
14. Creel Census. (H. W. Curran).		850.00	960.00	1,810.00
15. Experimental Verification of Natural Hybridization Between Species of Sun-fishes. (H. W. Curran).	Queen's University.	50.00	650.00	700.00
	Queen's University.	500.00	1,030.00	1,530.00
	Forward.....	\$1,400.00	\$2,640.00	\$4,040.00

RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
QUEEN'S UNIVERSITY BIOLOGICAL STATION—(Cont'd.)				
16. Aquatic Invertebrates as a Source of Food for Fish. (H. W. Curran).	Brought Forward..... Queen's University.	\$1,400.00 100.00	\$2,640.00 756.00	\$4,040.00 856.00
17. Limnological Survey of Lake Opinicon. (H. W. Curran).	Queen's University.	200.00	1,450.00	1,650.00
Publishing of Reports.	.....		300.00	300.00
Clerical Assistance.	.....		320.00	320.00
Purchase of Books.	.....	150.00		150.00
UNIVERSITY OF WESTERN ONTARIO				
18. Study of Ecological Factors of Lake Erie most likely to have influence on fish population.		\$1,850.00	\$5,466.00	\$7,316.00
Equipment.....				5,950.00
Maintenance.....				3,110.00
Salaries.....		5,950.00	3,110.00	4,340.00
Miscellaneous.....			3,600.00	3,600.00
UNIVERSITY OF TORONTO				
19. Caloric Requirements in Lake Trout. (F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	\$5,950.00 200.00	\$11,050.00 800.00	\$17,000.00 1,000.00
20. Movement of Lake Trout in Relation to Temperature. (F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	200.00	800.00	1,000.00
21. Quantitative Methods of Plankton Collection. (R. R. Langford).	Ontario Fisheries Research Laboratory.		1,350.00	1,350.00
22. Relation of Dissolved Minerals to Rate of Growth and Reproduction of Algae. (R. R. Langford; F. E. J. Fry).	Ontario Fisheries Research Laboratory.	1,000.00	2,350.00	3,350.00
Forward.....		\$1,400.00	\$5,300.00	\$6,700.00

RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
UNIVERSITY OF TORONTO—(Cont'd.) 23. Penetration of Light into Water. (R. R. Langford).	Brought Forward..... Ontario Fisheries Research Laboratory.	\$1,400.00 500.00	\$5,300.00 1,350.00	\$6,700.00 1,850.00
24. Supply and Fate of Chemical Nutrients in Lakes and the Chemical Analyses of Organisms. (R. R. Langford; F. E. J. Fry).	Ontario Fisheries Research Laboratory; Dept. of Lands and Forests.	600.00	1,050.00	1,650.00
25. Bibliographic Research. (F. E. J. Fry; R. R. Langford; F. P. Ide)	Ontario Fisheries Research Laboratory.		2,600.00	2,600.00
Organization of Ontario Fisheries Research Laboratory Library.			2,000.00	2,000.00
26. Lethal Limits of Temperature in Stream Insects with Special Reference to their Thermal History. (F. P. Ide; F. E. J. Fry).	Ontario Fisheries Research Laboratory.	100.00	1,000.00	1,100.00
27. Measurement of Environmental Factors such as humidity, Temperature, Light under Terrestrial Conditions. (A. F. Coventry).	.....	300.00	1,100.00	1,400.00
28. Toxicity Problem	.....			
		\$2,900.00	\$14,400.00	\$20,650.00

RECOMMENDED PROJECTS—FISHERIES AND WILDLIFE RESEARCH—1948-49—(Continued)

Title	Participating Agencies	Capital	Operating	Total
ROYAL ONTARIO MUSEUM OF ZOOLOGY				
29. Natural History Survey of Cape Henrietta Maria. (J. R. Dymond).		1,000.00	5,400.00	6,400.00
30. Wildlife Food Habits Research. (J. R. Dymond).		500.00	3,250.00	3,750.00
31. Reference Collection of Animal Parasites. (J. R. Dymond).			2,500.00	2,500.00
32. Compilation of Animal Population Records. (J. R. Dymond).			500.00	500.00
33. Lake Erie Fish Populations			3,000.00	3,000.00
34. Lake Herrings of the Great Lakes.			200.00	200.00
		\$1,500.00	\$14,850.00	\$16,350.00
ONTARIO RESEARCH FOUNDATION				
35. Parasitology.			26,975.00	26,975.00
			\$26,975.00	\$26,975.00

APPENDIX II.

SOILS

Committee:

Dr. H. B. Speakman (Chairman) . . .	Ontario Research Foundation.
Mr. L. J. Chapman (Secretary) . . .	Ontario Research Foundation.
Mr. G. A. Hills	Ontario Dept. of Lands and Forests.
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests.
Dr. A. Leahey	Central Experimental Farm, Ottawa.
Prof. F. F. Morwick	Chemistry, Ontario Agricultural College.
Mr. E. F. Palmer	Horticultural Experiment Station, Vineland.
Mr. F. L. Peckover	National Research Council.
Prof. D. F. Putnam	Geography, University of Toronto.
Mr. A. H. Richardson	Ontario Dept. of Planning and Development.
Prof. G. N. Ruhnke	Soils, Ontario Agricultural College.
Prof. W. L. Sagar	Civil Engineering, University of Toronto.
Mr. J. Walter	Ontario Dept. of Highways.
Prof. J. O. Wilhelm	Ontario Research Commission.

Meetings:

November 2nd, 1945	Ontario Research Foundation, Toronto.
April 4th, 1946	Ontario Research Foundation, Toronto.
July 3rd, 1946	Ontario Agricultural College, Guelph.
Sept. 23rd, 1946	Horticultural Experiment Station, Vineland.
May 22nd, 1947	Ontario Research Foundation, Toronto.
September 10th, 1947	Municipal Building, Cochrane.

SOILS RESEARCH IN ONTARIO

Interested Groups

Perhaps in no other field is there a greater need for a co-ordinated long-term program than in that of soils. Soils are of vital concern to Agriculture, and that concern is reflected in the activities of the Dominion and Provincial Departments of Agriculture. Soils data are key factors, and are recognized as such, in the work of the Ontario Department of Lands and Forests, the Ontario Department of Planning and Development, and the Ontario Department of Highways. Information on soils is of assistance to the Department of Mines and to those charged with the administration of game and fisheries. The work of the Ontario Research Foundation on Physiography and Climatology would be much more useful in an intelligent land-use program if correlated with an accurate and complete study of the soils in the Province. Such a study would be of tremendous value to educational groups in the teaching of geography. The importance of soils in the general economy is further attested by the recent setting up of the Associate Committee on Soil and Snow Mechanics within the National Research Council.

That each of the interested groups has done valuable work in this field is a matter of record; that there has been little, if any, duplication is rather amazing. This situation is due, no doubt, to the splendid co-operation which has existed. There is every reason to expect that the various groups would continue the present practice of mutual help and understanding, but, with the growing need for the immediate extension of our knowledge of soils throughout the whole Province, there can be no doubt that a program, planned and carried out by all, would meet the needs of each not only much more rapidly, but at considerable financial saving over a period of years.

It is apparent, then, that there is every opportunity for mutual help and co-ordinated effort on the part of the various groups concerned with the problem of soils. How best this can be promoted remains to be considered. Recommendations to this end were prepared by the Advisory Committee on Soils Research and are listed here.

Recommendations

For Co-ordination and Direction of Soils Research:

1. The establishment, on a permanent basis, of a central organization to co-ordinate a general program of research for the Province and to advise the Government thereon.
2. The establishment, by this organization, of an advisory committee on soils, its purpose being:
 - (a) to submit plans for the co-ordination of all soils research in the Province;
 - (b) to submit estimates of the cost of the suggested program;
 - (c) to correlate the data arising out of this research and to submit the results to the central organization;
 - (d) to advise the central organization on all matters pertaining to soils research, including such considerations as research personnel, scholarships, publications, etc.

General Program of Projects

1. The establishment of a greater number of scholarships to attract students to the field of Soils, with a view to correcting the present deficiency of qualified personnel in this field;
2. Renewal and extension of the program of Soils Survey, with a view to the complete mapping of the Province at the earliest date possible and to recognizing the particular urgency of the study of the soils in the northern clay belt;
3. Assistance to permit an expansion of activities in the fields of Climatology and Physiography, and the correlation of existing data in these studies with the data obtained in Soils Surveys;
4. The expansion of the program of the mapping and land-use direction of individual farms;

5. The encouragement of the co-operative study of fertility requirements and crop adaptation of various soil types;
6. Extension of the work on forest fixation, soils colloids and soil fertility;
7. Extension and encouragement of the work of river-valley development;
8. Provision for the inauguration of a program of waste-land reclamation and forest regeneration based on accurate information regarding the soils in the areas concerned:

Special Projects

The projects listed below have been selected because they involve fundamental problems bearing upon ultimate land-use, and because, at the present time, no systematic large scale work is being done on any one of them.

Some of these projects offer an excellent medium for co-operative research on the part of two or more institutions or departments, and can be broken down readily into sub-projects suitable for graduate students in several fields.

1. Physico-Chemical properties of Ontario soils affecting the erodability of important soil types;
2. A study of the physical, chemical and mineralogical character of the clays in the major soil types;
3. A study of water-borne sediments and soil nutrients in rivers as a measure of soil erosion losses from a watershed;
4. The rate of infiltration of rainfall into soils as related to run-off;
5. The distribution of cobalt, manganese and iodine in soils and crop plants in relation to the incidence of deficiency diseases in livestock;
6. An investigation of the sulphur content of the precipitation in various localities in relation to additions of sulphur to the soil.

RECOMMENDED PROJECTS—SOILS RESEARCH—1948-49

Title	Agency	Capital	Operating	Total
Physiography	Ontario Research Foundation	\$ 1,300.00	\$ 22,425.00	\$ 23,725.00

APPENDIX III.

AGRICULTURE

Committee:

Mr. C. F. Luckham (Chairman).....	Norfolk Specialty Farms.
Mr. Ken Betzner.....	Farmer, Waterloo.
Dr. H. D. Branion.....	Animal Nutrition, Ontario Agricultural College.
Prof. C. G. E. Downing.....	Agricultural Engineering, Ontario Agricultural College.
Prof. E. H. Garrard.....	Bacteriology, Ontario Agricultural College.
Dr. E. S. Hopkins.....	Central Experimental Farm, Ottawa.
Mr. Lawrence Kerr.....	Farmer, Chatham.
Prof. R. G. Knox.....	Animal Husbandry, Ontario Agricultural College.
Dr. A. L. MacNabb.....	Ontario Veterinary College.
Mr. M. H. McCurdy.....	Cockshutt Plow Company Limited.
Dr. G. P. McRostie.....	Field Husbandry, Ontario Agricultural College.
Dr. K. W. Neatby.....	Science Service, Dominion Dept. of Agriculture.
Mr. E. F. Palmer.....	Horticultural Experiment Station, Vineland.
Mr. A. Pitt.....	Massey-Harris Company, Limited.
Mr. F. W. Presant.....	Feed Division, Toronto Elevators Limited.
Prof. G. N. Ruhnke.....	Soils, Ontario Agricultural College.
Mr. G. A. Schell.....	Canada Packers Limited.
Mr. J. C. Steckley.....	Western Ontario Experimental Farm, Ridgetown.
Mr. W. G. Toner.....	Royal Dairy Products, Charles Yeates & Co. Ltd.
Mr. S. B. Trainer.....	Silverwood Dairies, Limited.
Mr. George Wilson.....	Ontario Dept. of Agriculture.
Mr. S. M. Young.....	International Harvester Company of Canada Ltd.
Prof. J. O. Wilhelm.....	Ontario Research Commission.

Meetings:

July 9th and 10th, 1946.....	Ontario Agricultural College, Guelph.
September 9th, 1946.....	Ontario Agricultural College, Guelph.
December 16th, 1946.....	Ontario Agricultural College, Guelph.

Sub-Committees:

Co-ordination

Dr. H. D. Branion (Chairman)...	Animal Nutrition, Ontario Agricultural College.
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Prof. C. G. E. Downing	Agricultural Engineering, Ontario Agricultural College.
Mr. C. F. Luckham	Norfolk Specialty Farms, St. Williams.
Mr. E. F. Palmer	Horticultural Experiment Station, Vineland.
Mr. George Wilson	Ontario Dept. of Agriculture.
Dr. E. S. Hopkins (advisory)	Central Experimental Farm, Ottawa.
Dr. K. W. Neatby (advisory)	Science Service, Dominion Dept. of Agriculture.

The report upon Agriculture requires a special preface. To understand clearly the present state of research in this field one must not fail to note that it is somewhat different from that obtaining in any of the other fields that have to do with natural resources. In Agriculture the need for a steadily expanding program of research is just as urgent as it is elsewhere, but the efforts of the workers to carry out such a program have been impeded by a peculiar combination of circumstances.

It is in this fact that one may see the reason why the Committee on Agriculture offers in this report no definite recommendations for an extended scheme of research. The Committee realizes the utter futility of making any recommendation of this kind at a time when it is obvious that the Ontario Agricultural College cannot assume an increased volume of work. The quality of the work done at the College and the competency of the staff are of the highest. But the unprecedented load of teaching now carried by the staff and their willing response to countless requests for extension and other services, are spreading out their store of energies so thin that the program of research they are craving to undertake is of necessity suffering. The effect of the paucity of research results is not felt keenly now, but in the event of a general economic recession the lack of new scientific knowledge of use to agriculture would be disastrous.

In the opinion of the Commission the situation constitutes a real problem which calls for an immediate endeavour to co-ordinate afresh the efforts of all the agencies concerned. The approach to the task should not be made in the spirit of adverse criticism of present effort. On the contrary, it should be co-operative and directed to working out without delay a plan whereby shortages of personnel in two departments in particular—extension and teaching—may be removed. Such a result would afford the competent research workers the freedom to devote a generous measure of their time, skill and energies to the great task of research for which they have been trained.

Beginnings of Research

Immediately after Confederation the Dominion Parliament embarked on a regular program of agricultural service, and within twenty years had set up numerous divisions, each charged with the responsibility for research and extension in a particular field. During the same period provincial programs of research and extension were developing just as rapidly and just as efficiently. For the most part, the provinces worked through the provincial universities, colleges and foundations, through agricultural representatives and through producers' organizations or individual producers. The work accomplished over the years has won for provincial Departments of Agri-

culture and their associates prestige and prominence equivalent to that enjoyed in the industry by the Dominion Department of Agriculture, and, while it is impossible to enumerate the contributions made, it should be pointed out that those contributions were particularly important in the fields of soils problems, crop production, animal production and the marketing of farm products.

Special Feature of Agricultural Research

The notable feature in agricultural research, a feature which sets it more or less apart from research in other fields, is that activity commonly known as extension work, which must be an integral part of practically every project. Since knowledge gained in the laboratory, the college plot or the experimental farm is of value only when made known to the "practical farmer", and since the vast majority of these are rugged individualists, the agencies interested in agricultural welfare and progress must carry on their extension work constantly.

Types of Research

Agricultural research, to be worthwhile, must cover the basic needs of production and of utilization. Research on production is well-established, and existing facilities could be expanded to meet the needs in this field, which includes soils surveys and proper land-use, plant production and improvement and animal production and improvement, each with its host of related topics and its extension program.

Far less attention has been paid to utilization. Of late years the needs in this field have been recognized and some start has been made on an overall program. It is recognized that the Dominion Government has a primary responsibility in this field, and is much better-equipped to promote the proposed campaign, but considerable contribution might be made by the Province. The importance to any industry of the utilization of its products requires no elaboration, and since agricultural production represents the work of hundreds of thousands of individuals, research leading to the maintenance of markets for that production must, of necessity, be a public responsibility. That research, which must be a major effort, includes the whole problem of markets with all the ramifications of world-trade problems, facilities for marketing, storage, transportation, processing, industrial utilization of farm products and nutrition. It includes, as well, research on land-settlement, farm credits, stabilized prices, farm labour, together with consideration of farm amenities and cultural activities. Agriculture, to be permanently progressive and remuneratively attractive, must be efficiently productive in regard to both quality and quantity of its products. It follows, surely, that agricultural research must have continuity and must be attractive to qualified personnel.

RECOMMENDED PROJECTS—AGRICULTURAL RESEARCH—1948-49

Title	Agency	Capital	Operating	Total
Industrial Utilization of Agricultural Products.	Ontario Research Foundation	\$ 2,000.00	\$ 18,000.00	\$ 20,000.00

APPENDIX IV.

MINES, MINERALS AND METALLURGY

Committee:

Mr. N. F. Parkinson (Chairman)	Ontario Mining Association.
Prof. H. S. Armstrong	Geology, McMaster University.
Prof. E. L. Bruce	Research Geology, Queen's University.
Prof. O. A. Carson	Metallurgy, Queen's University.
Dr. O. W. Ellis	Ontario Research Foundation.
Dr. C. S. Evans	Union Gas Company of Canada, Ltd.
Dr. G. S. Farnham	The International Nickel Company of Canada Ltd.
Dr. D. L. H. Forbes	The Teck-Hughes Gold Mines, Ltd.
Mr. T. W. Hardy	Climax Molybdenum Company.
Prof. J. E. Hawley	Mineralogy, Queen's University.
Prof. L. M. Pidgeon	Metallurgical Engineering, University of Toronto.
Prof. G. H. Reavely	Geology and Geography, University of Western Ontario.
Mr. H. C. Rickaby	Ontario Dept. of Mines.
Mr. R. H. Rimmer	Aluminium Laboratories Ltd.
Mr. W. Samuel	Steep Rock Iron Mines Ltd.
Mr. G. M. Thomson	General Engineering Company of Canada.
Mr. W. B. Timm	Dominion Dept. of Mines and Resources.
Dr. C. R. Whittemore	Deloro Smelting & Refining Co. Ltd.
Dr. G. E. Willey	Algoma Steel Corporation, Ltd.
Prof. C. G. Williams	Mining Engineering, University of Toronto.
Prof. J. T. Wilson	Physics, University of Toronto.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario.
Prof. J. O. Wilhelm	Ontario Research Commission.

Meetings:

September 12th, 1946	Parliament Buildings, Toronto.
November 15th, 1946	Parliament Buildings, Toronto.
May 28th, 1947	Parliament Buildings, Toronto.
November 21st, 1947	Parliament Buildings, Toronto.

Sub-Committees:

Ferrous Metallurgy

Dr. O. W. Ellis (Chairman)	Ontario Research Foundation.
Mr. P. E. Cavanagh (Secretary)	Ontario Research Foundation.
Mr. T. W. Hardy	Climax Molybdenum Company.
Mr. F. A. Loosley	Dominion Foundries and Steel Ltd.
Mr. W. Samuel	Steep Rock Iron Mines, Ltd.

Mr. R. J. Traill.....	Dominion Dept. of Mines and Resources.
Mr. D. G. Watt.....	The Hydro-Electric Power Commission of Ontario.
Dr. G. E. Willey.....	Algoma Steel Corporation, Ltd.
Mr. R. B. Young.....	The Hydro-Electric Power Commission of Ontario.

Wire Rope

Dr. O. W. Ellis (Chairman).....	Ontario Research Foundation.
Mr. I. A. Usher (Secretary).....	Ontario Research Foundation.
Mr. N. B. Brown.....	Dominion Dept. of Mines and Resources.
Mr. R. E. Dye.....	Dome Mines Ltd.
Mr. A. C. Halferdahl.....	National Research Council.
Mr. R. Healey.....	Wright-Hargreaves Mines Ltd.
Mr. D. T. Morris.....	Canada Wire & Cable Co. Ltd.
Mr. J. G. Morrow.....	Steel Company of Canada Ltd.
Mr. R. Parker.....	International Nickel Co. of Canada, Ltd.
Mr. N. F. Parkinson.....	Ontario Mining Association.
Mr. R. S. Segsworth.....	General Engineering Co. (Canada) Ltd.
Mr. D. G. Sinclair.....	Ontario Department of Mines.
Mr. L. W. Sproule.....	Imperial Oil Limited.
Mr. R. B. Young.....	The Hydro-Electric Power Commission of Ontario.

Both the Federal and the Provincial Governments have long recognized a considerable responsibility for the encouragement of the mining and metallurgical industries.¹ The importance of these industries in the economy of Ontario² makes their stability a matter of major concern to Provincial authorities, not only from the standpoint of social welfare but from that of revenue. And ownership of the mineral resources imposes on the Province the primary responsibility for their careful utilization.

There are two essentials for continuing stability in these industries. Since mineral resources are irreproducible they should be exploited with the minimum of waste, and since all properties must ultimately become exhausted there must be a continuous and systematic search for new ore bodies. Obviously the processing of ores currently being raised will receive the most careful scrutiny by those working with them. But the task of an inventory of untapped ore bodies—whether untapped because of complexity of ores or because they are still undiscovered—must be undertaken by the Government for obvious reasons.

To both these ends—more efficient recovery and a reliable inventory—research is necessary. Methods of processing of ores currently unprofitable must be sought. A complete inventory will be possible only through the discovery of new prospecting tools. To be successful today prospecting must

¹For a complete statement of the work done by governments to 1933, see: Federal: Canada, Department of Mines, 1933.

Provincial (Ontario): The Mining Laws of Ontario and the Department of Mines, (T. W. Fisher, 1933).

²See figures submitted in the Report of the Royal Ontario Mining Commission, 1944.

enlist the aid of the chemist and the geophysicist as well as that of the geologist. The current tools of geophysics are the comparatively crude ones of a science just becoming established, but a science which promises to be one of greater and greater value in mineral inventory work.

There are several metallurgical problems which merit immediate research. Some of these are as follows:

1. The better utilization of iron ores and fuels;
2. The recovery of apatite from crystalline limestone;
3. The discovery and recovery of radioactive and rare earth minerals;
4. The extraction of aluminum from the complex ores on Parry Island;
5. The greater development of the non-metallic (industrial) minerals;
6. The discovery of alternative sources of fuel supply;
7. The cataloguing and analysing of the results of previous research to make accessible information already in existence but now quite inaccessible.

The first of these problems, the better utilization of iron ores and fuels, seemed of sufficient urgency to justify immediate action. For that reason an investigation directed by the Ontario Research Foundation was initiated by the Commission. A second project, one concerning the manufacture and use in practice of mine hoisting ropes, was also instituted. While it, too, is directed by the Ontario Research Foundation, it is essentially a co-operative undertaking on the part of the Government, the Foundation, the mines, and the manufacturers of wire rope. It should be noted here that in both these projects close liaison is maintained with the Federal Department of Mines through representatives of the latter on each of the project committees.

Facilities for mining and metallurgical research seem reasonably adequate at the present time. The Federal Bureau of Mines is particularly well equipped to do research of a public, semi-public or private nature. The Foundation is in a similar position. These laboratories can be supplemented by those of the various universities. The present policy of the Provincial Department of limiting its direct research efforts to the field of Geology, while sponsoring other projects using the facilities mentioned is a commendable one. The Geological Branch has rendered considerable service in the assessment of existing tools of geophysics, the inadequacy of which has seemingly handicapped it. It is still further handicapped by the multiplicity of methods used in the geological mapping by Provincial and Dominion services. Ontario might well give some leadership in the establishment of some uniformity so that existing information might be more readily accessible.

RECOMMENDED PROJECTS—MINES, MINERALS AND METALLURGICAL RESEARCH—1948-49

	Participating Agencies	Capital	Operating	Total
UNIVERSITY OF TORONTO		\$	\$	\$
1. Geothermal Studies (A. D. Misener).	Ontario Department of Mines; Mining industries.	700.00	2,300.00	3,000.00
2. Magnetic Studies. (A. A. Brant).	Ontario Department of Mines; Mining industries.	1,000.00	2,000.00	3,000.00
3. Radioactive Studies. (J. T. Wilson)	Ontario Department of Mines; Mining industries.	450.00	2,550.00	3,000.00
4. X-ray Diffraction Research (M. A. Peacock)	Ontario Department of Mines.	3,870.00	3,197.00	7,067.00
		\$ 6,020.00	\$10,047.00	\$16,067.00
QUEEN'S UNIVERSITY				
5. Spectrographic Research. (J. E. Hawley).	Bureau of Mines, Ottawa.	\$15,000.00	\$ 5,000.00	\$20,000.00
ONTARIO RESEARCH FOUNDATION				
6. Wire Rope Project. (O. W. Ellis, I. A. Usher).	Ontario Department of Mines; Bureau of Mines, Ottawa; Mining industries.	4,250.00	23,200.00	27,450.00
7. Reduction of Ferrous Ores. (O. W. Ellis, P. E. Cavanagh)	Ontario Department of Mines; Bureau of Mines, Ottawa; Mining industries.	5,750.00	16,350.00	22,100.00
		\$10,000.00	\$39,550.00	\$49,550.00
McMASTER UNIVERSITY				
8. Geochemical Studies (H. S. Armstrong).	.....			\$ 5,000.00
				\$90,617.00

APPENDIX V.

FORESTRY

Committee:

Dean J. W. B. Sisam (Chairman)	Forestry, University of Toronto.
Prof. C. E. Atwood	Zoology, University of Toronto.
Mr. A. B. Baird	Dominion Parasite Laboratory, Belleville.
Dr. John E. Bier	Dominion Laboratory of Forest Pathology, Toronto.
Mr. W. Boyd Campbell	Pulp and Paper Research Institute of Canada.
Mr. G. G. Cosens	Kimberly-Clark Corporation Limited.
Mr. C. B. Davis	Abitibi Power and Paper Company Ltd.
(Substitutes: Mr. W. E. Willson and Mr. J. B. Mathews)	Abitibi Power and Paper Company Ltd.
Mr. W. A. Delahey	Abitibi Power and Paper Company Ltd.
Mr. W. A. Delahey	Great Lakes Paper Co.
Dr. G. H. Duff	Botany, University of Toronto.
Mr. T. L. Dunbar	Consultant.
Prof. R. O. Earl	Biology, Queen's University.
Mr. D. A. Gillies	Gillies Bros. & Co. Ltd.
Mr. J. H. Godden	Great Lakes Paper Company.
Dr. O. Holden	The Hydro-Electric Power Commission of Ontario.
Prof. R. C. Hosie	Forestry, University of Toronto.
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests.
Maj.-Gen. H. Kennedy	Consulting Engineer.
Mr. A. Koroleff	Pulp and Paper Research Institute of Canada.
Mr. W. J. LeClair	Canadian Lumbermen's Association.
Mr. G. A. Ledingham	National Research Council Regional Laboratory, Saskatoon.
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests.
Mr. D. A. Macdonald	Dominion Forest Service.
Mr. F. A. MacDougall	Ontario Dept. of Lands and Forests.
Dr. H. B. Marshall	Ontario Research Foundation.
Mr. T. A. McElhanney	Forest Products Laboratories, Ottawa.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto.
Mr. C. R. Mills	Ontario Forest Industries Association.
Dr. M. L. Prebble	Forest Insect Laboratory, Sault Ste. Marie.
Mr. A. H. Richardson	Ontario Dept. of Planning and Development.
(Substitute: Mr. A. S. L. Barnes)	Ontario Dept. of Planning and Development.
Mr. K. O. Roos	Booth Lumber Limited.
Mr. S. J. Staniforth	Staniforth Lumber Co. Ltd.
Mr. G. H. Tomlinson, II	Howard Smith Paper Mills Limited.
Prof. J. O. Wilhelm	Ontario Research Commission.

Meetings:

February 20th, 1946.....	Ontario Research Foundation, Toronto.
September 26th, 1946.....	Parliament Buildings, Toronto.
November 25th, 1946.....	Parliament Buildings, Toronto.
March 6th, 1947.....	Chateau Laurier, Ottawa.
September 29th, 1947.....	Forest Insect Laboratory, Sault Ste. Marie.
November 26th, 1947.....	Parliament Buildings, Toronto.

Sub-Committees:

Waste Sulphite Liquor

Dr. H. B. Marshall (Chairman) ..	Ontario Research Foundation.
Dr. G. A. Adams.....	National Research Council.
Dr. F. Bender.....	Forest Products Laboratories, Ottawa.
Dr. W. Boyd Campbell.....	Pulp and Paper Research Institute of Canada.
Dr. G. A. Ledingham.....	National Research Council Regional Laboratory, Saskatoon.
Prof. R. R. McLaughlin.....	Chemical Engineering, University of Toronto.
Dr. G. H. Tomlinson, II.....	Howard Smith Paper Mills Limited.
Dean J. W. B. Sisam (ex officio) ..	Forestry, University of Toronto.
Prof. J. O. Wilhelm (ex officio) ..	Ontario Research Commission.

Sawmilling Practice

Dean J. W. B. Sisam (Chairman) ..	Forestry, University of Toronto.
Mr. W. J. LeClair.....	Canadian Lumbermen's Association.
Mr. T. A. McElhanney.....	Forest Products Laboratories, Ottawa.
Mr. K. O. Roos.....	Booth Lumber Limited.
Prof. J. O. Wilhelm (ex officio) ..	Ontario Research Commission.

Waste Slabwood Utilization

Dean J. W. B. Sisam (Chairman) ..	Forestry, University of Toronto.
Mr. W. J. LeClair.....	Canadian Lumbermen's Association.
Mr. T. A. McElhanney.....	Forest Products Laboratories, Ottawa.
Prof. J. O. Wilhelm (ex officio) ..	Ontario Research Commission.

Biological Forestry

Prof. C. E. Atwood.....	Zoology, University of Toronto.
Mr. A. B. Baird.....	Dominion Parasite Laboratory, Belle- ville.
Mr. G. G. Cosens.....	Kimberly-Clark Corporation of Canada, Limited.
Mr. W. A. Delahey.....	Great Lakes Paper Co.
Dr. G. H. Duff.....	Botany, University of Toronto.
Prof. R. O. Earl.....	Biology, Queen's University.
Prof. R. C. Hosie.....	Forestry, University of Toronto.
Mr. R. N. Johnston.....	Ontario Dept. of Lands and Forests.

Maj.-Gen. H. Kennedy	Consulting Engineer.
Mr. A. P. Leslie	Ontario Dept. of Lands and Forests.
Mr. D. A. Macdonald	Dominion Forest Service.
Mr. C. R. Mills	Ontario Forest Industries Association.
Mr. K. O. Roos	Booth Lumber Limited.
Dean J. W. B. Sisam	Forestry, University of Toronto.
Mr. W. E. Willson	Abitibi Power and Paper Company Ltd.
Prof. J. O. Wilhelm (ex officio) . .	Ontario Research Commission.

The direct and indirect results of forest depletion are too well known to require enumeration here. Scattered throughout the Province are river valleys which are depressing reminders of those results. Depletion can be prevented only by positive policies of conservation—policies which are timeless in viewpoint and which are backed by sufficient capital for long-term investment and by sufficient authority to control effectively all those who seek to exploit the forests. The Provincial Government has the responsibility of instituting and maintaining such policies.

Since building activity is so sensitive to business conditions the lumbering industry is and always has been subject to wide fluctuations. This sensitiveness is of considerable importance to conservation for it implies a rapid turnover in the firms participating in the industry. The very insecurity of the enterprise has encouraged ruthless exploitation in times of boom while in times of depression the disappearance of firms or the need for retrenchment has made for neglect. The present preponderance of interest in pulp and paper points to a happier situation. High fixed capital costs mean that participating firms have a considerable stake in sound management. As a result, public and private interests are more compatible. But private conservation measures cannot be completely adequate since conservation policies must be formulated in terms of whole drainage basins.

It should be unnecessary to review past and present government activities in forest protection and forest management. Much has been done and much is being done. But even more remains to be done. The task is no longer one of merely protecting the gifts of Nature. Her beneficence must be fortified by direct assistance, and piecemeal policies must be supplanted by overall management.

Such assistance implies the existence of adequate forest knowledge and the fullest possible use of that knowledge. But there are many gaps in the information required and many gaps in the application of what is already known. One major deficiency is the lack of an adequate forest inventory—an inventory which must include not only complete data regarding existing stands but information regarding the rates of growth and the rates of depletion. A prerequisite to intelligent management of our forest resources is a reliable inventory of our forest assets.

The gaps in existing forest knowledge can be filled only by research. And, to a lesser extent, research is required to facilitate the best application of the information presently available. In neither case can forestry research be completely divorced from that in related fields. It must be correlated to the work being done in Soils, Agriculture, and Fisheries and Wildlife. It should look to Aerial Photography, Physiography and Climatology for assistance and it must not ignore the effects of air and water pollution.

The task then is one calling for the co-ordination of many talents over a considerable period of time. With this in view the following recommendations are submitted as a guide for correlation of effort in the setting up of specific research programs:

1. The Problem of Co-ordination and Continuity in Personnel and Administration

- (a) The establishment of a permanent central body to
 - 1. which representations may be made concerning researches in forestry and the related fields;
 - 2. assess and correlate the research projects of these groups;
 - 3. advise the Government as to the financial assistance required to implement the research program devised;
 - 4. encourage the distribution of all available information;
 - 5. assist in the provision of the personnel required.
- (b) The encouragement of undergraduate and graduate studies and related fields by
 - 1. the establishment of a system of scholarships and other aids of adequate value to retain the best research personnel available;
 - 2. the continuation by the Provincial Department of Lands and Forests of the policy of recruiting departmental personnel from among those having university training in Forestry and related fields;
 - 3. the continuation of the policy of summer employment in summer forest projects for graduate and undergraduate students;
 - 4. the extension of staff and facilities for graduate work in the Faculty of Forestry, University of Toronto.
- (c) The establishment as soon as possible of an ecological centre.

2. Research Program

(a) Forest Ecology.

The correlation, with a view to securing a comprehensive land-use classification, of all the data obtained by

- 1. completion of an adequate Provincial soils survey;
- 2. extension of the studies in Physiography and Climatology;
- 3. studies on the microbiology of forest soils.

(b) Forest Management.

1. Inventory:

- (i) A comprehensive survey of existing forest resources;
- (ii) Investigation of the rates of growth under varying conditions of tree distribution and age of stands, both natural and controlled;

- (iii) Investigation of techniques of aerial photography and associated inventory methods.

2. Regeneration:

- (i) Investigation of regeneration in (a) burnt-over and cut-over areas (b) swamp areas;
- (ii) Studies of the silvicultural characteristics of the native tree species in order of commercial importance;
- (iii) Genetical studies of native and valuable exotic species with the object of improving silvicultural characteristics;
- (iv) Design of more efficient tree planting and general nursery machinery;
- (v) The development of artificial seeding techniques and equipment.

3. Applied Forestry:

- (i) Investigations of farm woodlot management;
- (ii) Establishment of management areas to investigate and demonstrate the value of various silvicultural practices;
- (iii) Logging studies on various forest types to determine the best methods of removing the forest crop in relation to the cost of (a) delivering wood to the mill and (b) restoring the forest crop.

(c) Forest Protection.

1. Biological:

- (i) Investigation of losses from and long-term effects of insects, animals and disease;
- (ii) Methods of control of insects and disease;
- (iii) The effect of different cutting methods on (a) fire hazards, and (b) biology of the forest.

2. Fire:

- (i) The development and design of specialized equipment for forest fire detection and suppression;
- (ii) Investigation of accurate rating for fire hazards;
- (iii) Investigation of fire weather forecasting.

(d) The Problem of Utilization.

1. Present Wastages:

- (i) Investigations of existing wood wastes to secure profitable uses for
 - (a) logging wastes;
 - (b) milling and manufacturing wastes.

- (ii) Better utilization of materials, for example,
- (a) more efficient manufacturing methods;
 - (b) complete fabrication of existing products;
 - (c) utilization of present non-commercial tree species;
 - (d) development of a wider range of valuable forest products.
- (e) Forest Hygiene
- (i) The study of air and water pollution and their effect on the forest and on the community.

RECOMMENDED PROJECTS—FORESTRY RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
QUEEN'S UNIVERSITY BIO-LOGICAL STATION				
1. Forest Regeneration and Woodlot Management. (R. O. Earl).	Queen's University.	\$ 315.00	\$ 1,185.00	\$ 1,500.00
2. Biology of the Basswood Leaf Miner. (A. S. West).	Queen's University.		690.00	690.00
3. Insects as Vectors of Bacteria. (A.S. West).	Queen's University.		2,720.00	2,720.00
4. Forest Insect Investigations. (A. S. West).	Queen's University.		900.00	900.00
		\$315.00	\$5,495.00	\$5,810.00
UNIVERSITY OF TORONTO				
5. Sawmill practice research. (W. G. McIntosh).	Department of Lands and Forests, Ontario Forest Products Laboratory, Ottawa.		10,000.00	10,000.00
6. Forest Tree Mycorrhiza. (G. H. Duff).	Department of Lands and Forests, Ont.		900.00	900.00
7. Regeneration Studies.	Department of Lands and Forests, Ont.; Forest Products Laboratory, Ottawa.		10,000.00	10,000.00
			\$20,900.00	\$20,000.00
ONTARIO RESEARCH FOUNDATION				
8. Waste Sulphite Liquor Utilization (H. B. Marshall).	.....		\$ 1,200.00	\$ 1,200.00
9. Wood Chemistry.	.....	2,000.00	18,000.00	20,000.00
		\$2,000.00	\$19,200.00	\$21,200.00
Unclassified as Yet.	.....			2,090.00
				\$50,000.00

APPENDIX VI.

INDUSTRY

Committee:

Mr. E. T. Sterne (Chairman)	G. F. Sterne & Sons Limited (Industrial Chemicals).
Mr. Thomas E. Boyce	Disher Steel Construction Co. Ltd.
(Substitute:	
Mr. Howard Chamberlain)	Lowe Bros. Co. Ltd. (Paints).
Mr. T. A. Faust	Yocum Faust Limited (Industrial Chemicals).
Mr. G. C. Bernard	Canadian Manufacturers' Association Inc.
Mr. F. J. Lyle	Ontario Dept. of Planning and Development.
Mr. Lorne S. Campbell	Ontario Dept. of Planning and Development.
Dr. H. B. Speakman	Ontario Research Foundation.
Mr. A. B. Ward	Ontario Research Foundation.
Mr. D. F. MacRae	Ontario Research Foundation.
Prof. J. O. Wilhelm	Ontario Research Commission.

Meetings:

April 14th, 1947	Ontario Research Foundation, Toronto.
May 9th, 1947	Ontario Research Foundation, Toronto.
June 18th, 1947	Ontario Research Foundation, Toronto.
September 12th, 1947	Ontario Research Foundation, Toronto.
November 4th, 1947	Ontario Research Foundation, Toronto.
December 1st, 1947	Ontario Research Foundation, Toronto.

Following the publication of the Interim Report of the Commission a working committee was set up comprising two members of the Department of Planning and Development, two from the Ontario Research Foundation, two from the Ontario Division of the Canadian Manufacturing Association, the Manager of the Ontario Division of the Canadian Manufacturers' Association and a member of the Ontario Research Commission as Chairman.

The Committee has been studying the problem and reports the progress made up to the present.

In the submission presented by the Ontario Division of the Canadian Manufacturers' Association and published in the Interim Report the following three suggestions were made:

1. Creation of a program conducted by the Ontario Research Foundation and designed to bring the work and facilities of the Foundation to the attention of manufacturers in the Province, and in particular to the smaller manufacturers;
2. Further exploration by the Foundation of the possibilities of bringing groups of industries with common problems into a closer relationship with the Foundation for the purpose of solving these problems on a basis of mutual benefit;

3. The encouragement of organizations of scientific and productive personnel within broad groups of industries, particularly those maintaining research facilities of their own, for the interchange of ideas and information which would help all these industries in their work.

In the spring of 1947 at the request of the Ontario Research Commission the Government made available the necessary funds to initiate the program and arrangements for the additional space required are in process of completion.

Your Committee can report definite progress.

With regard to the first of the recommendations made by the Canadian Manufacturers' Association the Ontario Research Foundation has been able to secure a thoroughly competent chemical engineer to head up a department co-operating with the Department of Planning and Development and with individual manufacturers. This department is known as the Ontario Industrial Research Service. Already more than 260 firms have made inquiries and of these 165 have led to laboratory work in the four months the Service has been in operation. The services being rendered exceed expectations and are taxing existing personnel and facilities. The future of this division promises to be of great service to our industries, large and small.

The carrying out of the second recommendation of the Canadian Manufacturers' Association respecting group research has met with some delays, but with the co-operation of the Canadian Manufacturers' Association and its committees this work will soon be begun.

The third recommendation involves a long-term policy based, to a large extent, on the first two recommendations. The work involved will have to be done in close co-operation with the Canadian Manufacturers' Association. The body that may be set up to carry this out will be responsible for directing this activity and maintaining interest in it.

A fourth recommendation designed to promote the training and wide distribution of trained technical personnel throughout industry, should have the leadership of the continuing organization that will work with the Canadian Manufacturers' Association, the Technical Service Council and other interested groups.

This Committee recommends that a permanent continuing committee of the Council be instituted, that its membership be based upon the same principle of representation as that upon which the present committee is based, and that at least one member of the Council sit with the Committee at its sessions.

RECOMMENDED PROJECTS—INDUSTRIAL RESEARCH—1948-49

Title	Participating Agencies	Capital	Operating	Total
ONTARIO RESEARCH FOUNDATION				
1. Ontario Industrial Research Service.	Ontario Industries.	\$	\$ 38,500.00	\$ 38,500.00
2. Group Research.	Ontario Industries.		25,000.00	25,000.00
			63,500.00	63,500.00

APPENDIX VII.

INDUSTRIAL WASTE

Committee:

Mr. E. T. Sterne (Chairman)	G. F. Sterne & Sons Limited (Industrial Chemicals).
Dr. A. E. Berry	Ontario Dept. of Health.
Mr. G. A. H. Burn	Ontario Dept. of Health.
Prof. A. C. Plewes	Chemical Engineering, Queen's University.
Dr. H. B. Speakman	Ontario Research Foundation.
Mr. A. V. DeLaporte	Ontario Dept. of Health.
Prof. R. R. McLaughlin	Chemical Engineering, University of Toronto.
Prof. J. O. Wilhelm	Ontario Research Commission.

Meetings:

June 18th, 1947	Ontario Research Foundation, Toronto.
July 17th, 1947	Ontario Research Foundation, Toronto.
September 12th, 1947	Ontario Research Foundation, Toronto.
November 4th, 1947	Ontario Research Foundation, Toronto.
December 4th, 1947	Ontario Research Foundation, Toronto.

At the request of the Ontario Research Commission a Committee was set up to study the overall problem of industrial wastes, and to recommend procedures to solve the problems bearing upon the eventual use or disposal of these wastes.

As Ontario becomes more densely populated, as the forests are cut down and the rivers and ground waters decrease in volume, industrial wastes increase and the problem of their disposal is progressively enlarged and each day becomes more urgent.

The Department of Health has submitted the following information and comment:

The industries in Ontario in which problems arising from the disposal of waste are the cause of great public concern include the following:

1. The milk industry, including all types of processing plants;
2. The canning industry;
3. Other food industries, including meat packing plants, food drying plants, processing plants, soft drinks, etc.;
4. Leather tanning;
5. Pulp and paper plants;
6. Oil wells and refineries;
7. Rubber manufacturing;
8. Woollen and textile plants;

9. Plants for producing many kinds of industrial chemicals, for example: 2-4-D;
10. Manufacture of plastics;
11. Breweries and distilleries;
12. Metal working;
13. Gas and coke manufacturing;
14. Laundries.

NOTE: These industries are widespread in Ontario and they are increasing in numbers and in variety and quantity of products. Many of these industries discharge their wastes into public sewers and thereby create problems for municipalities. Other wastes are discharged direct into natural bodies of water such as lakes and rivers. New processes are continually being developed and these involve changing types of wastes.

The problem of waste disposal involves environmental sanitation and economics. The best results can be obtained only when research is conducted continuously and effectively.

As the milk industry is widely distributed all over the Province and is mainly in small plants with poor or no disposal facilities, your Committee has asked the Department of Health to estimate the financial requirements for launching work upon this disposal problem. This estimate is being submitted.

It is very plain from a study of the list of industries above that the problem of milk waste involves only the first of a long series of researches which must be undertaken in the whole field of waste disposal. The health of our people and the productivity of our industries are so dependent on finding solutions to the several problems of disposing of wastes that this work should be carried on with persistence and with courage.

The Experimental Station of the Ontario Department of Health in which much of this work might be carried on was constructed at Toronto in 1907. The main part of the building is in very poor condition. There is an obvious need for more adequate facilities for this type of work and it is strongly recommended that such facilities be provided.

Your Committee recommends that as the program progresses a similar continuing Committee with additional industrial representation be set up to further this work.

RECOMMENDED PROJECTS—INDUSTRIAL WASTE COMMITTEE— 1948-49

Title	Agency	Capital	Operating	Total
Milk Waste Disposal and Utilization.	Department of Health, Ontario.	\$	\$ 15,000.00	\$ 15,000.00

APPENDIX VIII.

HIGHWAYS

Committee:

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association.
Mr. H. N. Lamont (Secretary)	Ontario Dept. of Highways.
Mr. T. N. Carter	Ontario Road Builders' Association.
Mr. L. J. Chapman	Ontario Research Foundation.
Mr. D. J. Emrey	County Engineer, Kitchener.
Mr. T. F. Francis	Ontario Dept. of Highways.
Mr. W. B. Hastings	Ontario Motor League.
Mr. A. K. Hay	Federal District Commission.
Prof. R. A. Low	Civil Engineering, Queen's University.
Mr. J. A. P. Marshall	Ontario Dept. of Highways.
Dr. N. W. McLeod	Imperial Oil Limited.
Mr. W. J. Moore	Ontario Good Roads Association.
Mr. C. A. Robbins	Ontario Dept. of Highways.
Mr. D. O. Robinson	Canada Cement Company.
Prof. W. L. Sagar	Civil Engineering, University of Toronto.
Mr. J. Walter	Ontario Dept. of Highways.
Mr. R. B. Young	The Hydro-Electric Power Commission of Ontario.
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission.

Meetings:

June 10th, 1947	Parliament Buildings, Toronto.
September 25th, 1947	Parliament Buildings, Toronto.
November 28th, 1947	Parliament Buildings, Toronto.
January 16th, 1948	Parliament Buildings, Toronto.

Sub-Committees:

Organisation

Mr. W. S. McKay (Chairman)	Ontario Good Roads Association.
Mr. D. J. Emrey	County Engineer, Kitchener.
Mr. T. F. Francis	Ontario Dept. of Highways.
Mr. H. N. Lamont	Ontario Dept. of Highways.
Prof. R. A. Low	Civil Engineering, Queen's University.
Dr. N. W. McLeod	Imperial Oil Limited.
Mr. J. Walter	Ontario Dept. of Highways.
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission.

Planning, Economics and Administration

Prof. R. A. Low (Chairman)	Civil Engineering, Queen's University.
Mr. A. E. K. Bunnell	Ontario Dept. of Planning and Develop- ment.
Mr. W. A. Clarke	Division Engineer.
Mr. G. R. Marston	County Engineer.
Mr. W. J. Fulton	Ontario Dept. of Highways.
Mr. J. M. MacInnes	Ontario Dept. of Highways.
Mr. J. L. Zoller	Ontario Dept. of Highways.

Soils and Foundations

Mr. J. Walter (Chairman).....Ontario Dept. of Highways.
Mr. D. J. Emrey.....County Engineer.
Prof. R. A. Low.....Civil Engineering, Queen's University.
Mr. D. McGinnis.....Contractor, Kingston.
Dr. N. W. McLeod.....Imperial Oil Limited.
Mr. D. G. Watt.....The Hydro-Electric Power Commission
of Ontario.

Design

Mr. D. J. Emrey (Chairman)...County Engineer.
Mr. T. F. Francis.....Ontario Dept. of Highways.
Mr. R. M. Lee.....County Engineer.
Dr. N. W. McLeod.....Imperial Oil Limited.
Mr. D. G. Ramsay.....Ontario Dept. of Highways.
Mr. D. O. Robinson.....Canada Cement Company.
Mr. J. Walter.....Ontario Dept. of Highways.

Materials and Construction

Mr. T. F. Francis (Chairman)...Ontario Dept. of Highways.
Mr. C. Fraser.....Ontario Dept. of Highways.
Mr. T. Johnston.....Ontario Dept. of Highways.
Mr. E. W. Jones.....County Engineer.
Mr. T. R. Patterson.....County Engineer.
Prof. W. L. Sagar.....Civil Engineering, University of Toronto.

The results of the deliberations of this Committee are embodied in two resolutions:

1. That the Department of Highways be approached with a view to ascertaining whether or not, and to what extent, the Department would consider participating in a joint library scheme.

It was felt that present Highway Library facilities could be utilized to much better advantage than in establishing a new and independent library. This proposal is designed to provide adequate facilities and be of mutual benefit to the Department and the Highway Research body.

The following features are considered to be necessary in order to render an efficient service:

1. A trained librarian and adequate staff
 - (a) organize and index the existing facilities according to some definite system, e.g. the Legislative Library, Highway Research Board, National Library;
 - (b) draw upon other sources for technical information and index the data so obtained;
 - (c) make this information available to all interested parties.
2. Extension of the present Department of Highways Library to provide adequate space for all requirements, including study and reading purposes. In allotting such space, ample provision should be made

not only for present requirements, but also for future expansion so that the original set up need not be unduly disturbed;

3. Provide an extension service to highway, county, township and municipal engineers and other interested parties, who would thereby have available information on the latest investigations in current highway practices.

Such a library might be established as one unit of a general co-operative library scheme designed to provide a comprehensive scientific library service for Government departments and other scientific groups in and about the Toronto area.

2. That a highways research program be now undertaken.

The following were selected as the subjects wherein further research is deemed to be most urgently needed, viz.:

1. Supporting Value of Subgrade Soils and Base Courses;
2. Soil Compaction and Frost Action of Subgrade Soils;
3. Durability of Bituminous and Concrete Aggregates;
4. Inventory of Granular Materials;
5. Design of Concrete and Bituminous Pavements.

The selection of these subjects was approved by the General Committee after careful consideration by its four sub-committees. As a helpful guide to them in making this selection they had available the answers to a questionnaire sent out by the Committee to 117 engineers, including every city, county and district engineer. This questionnaire listed fifteen highways research subjects and the recipient was asked to indicate which of these he considered most important and also the order of their importance, and to add to the list any subject which he thought should be included.

Answers to the questionnaire were received from 48 engineers. These answers were then classified. The five subjects above named were selected as deserving priority of attention in the proposed Highways Research program. Each of these subjects was then assigned to the particular sub-committee or sub-committees to which it appeared to belong. This procedure enabled the Committee to consider what steps should be taken to carry out the research required.

Of the several agencies which might be expected to participate in the carrying out of such a research program the Committee recognizes that the Department occupies a position of paramount importance, and that it is already engaged in a limited program of highway research.

The Committee's recommendations if adopted by the Department would involve, therefore, simply an expansion and possible intensification of the present program. Such an expansion would probably require the employment of additional trained personnel for full time research work, the purchase from time to time of additional research equipment, and an increased annual expenditure on account thereof.

The Committee's estimate of the amount which would be required each year to finance the carrying out of such a program of research is \$250,000. In a year when the total provincial expenditure on highways was \$50,000,000

or over, the spending of \$250,000 for highways research would represent not over $\frac{1}{2}$ of 1% (one-half of one per cent) of the total. That this is a comparatively modest percentage is evident from a comparison with the percentage expended for research in other cases, e.g. 8/10 of 1% in Great Britain, 1% in U.S.A., 1% in Russia and 1% in Canada at the Dominion level. Furthermore, if the amount estimated as being required to cover the cost of such a program seems high, the possible cost to the Province of failing to pursue such a program must not be lost sight of.

APPENDIX IX.

AERIAL SURVEY

Committee:

Prof. K. B. Jackson (Chairman)	Applied Physics, University of Toronto
Mr. J. R. M. Austin	Austin Airways Limited.
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Mr. J. A. Brodie	Ontario Dept. of Lands and Forests
Mr. L. J. Chapman	Ontario Research Foundation
Dr. W. Clark	Eastman Kodak Company
Dr. D. R. Derry	Ventures, Limited.
Mr. W. J. Fulton	Ontario Dept. of Highways
Mr. G. Godwin	The Ontario Paper Company, Limited
Dr. L. E. Howlett	Optics Section, National Research Council
Mr. M. E. Hurst	Ontario Dept. of Mines
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Company, Limited
Mr. Tom C. McCall	Ontario Dept. of Travel and Publicity
Mr. C. R. Mills	Ontario Forest Industries Association
Prof. F. F. Morwick	Ontario Agricultural College
Prof. J. E. Reid	Electrical Engineering, University of Toronto
Mr. A. H. Richardson	Ontario Dept. of Planning and Development
Mr. J. R. G. Smyth	Ontario Dept. of Lands and Forests
Prof. W. M. Treadgold	Civil Engineering, University of Toronto
Prof. J. O. Wilhelm (ex officio)	Ontario Research Commission

Meetings:

April 22nd, 1947	Parliament Buildings, Toronto
January 5th, 1948	Engineering Building, University of Toronto

Sub-Committees:

Photography

Mr. J. R. M. Austin	Austin Airways Limited
Mr. J. M. Bishop	Ontario Dept. of Lands and Forests
Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. R. N. Johnston	Ontario Dept. of Lands and Forests
Mr. D. N. Kendall	Photographic Survey Company, Limited

Photogrammetry

Prof. K. B. Jackson	Applied Physics, University of Toronto
Mr. K. H. Siddall	Ontario Dept. of Highways
Prof. W. M. Treadgold	Civil Engineering, University of Toronto
Mr. J. G. Wilkenson	Photographic Survey Company, Limited

An informal conference on Aerial Survey was held on March 13th, 1947. As a result, a submission was made to the Ontario Research Commission on

April 8th recommending the establishment of an Advisory Committee on Aerial Survey, the Committee to include representatives of:

1. Government agencies which produce or use aerial photographs;
2. University departments concerned with the individual problems of aerial photography and the application of aerial photographs in their respective subject areas;
3. Photographic surveying companies;
4. Manufacturers of photographic materials, and of photo-survey equipment.

The general problem which was placed before the Committee involved:

1. Photography:

- (a) Choice of photographic materials and processes to suit general or specific needs;
- (b) Choice or design of suitable camera equipment;
- (c) Application of navigational aids, camera stabilizers and automatic pilots;
- (d) Determination of scale requirements for specific purposes.

2. Photogrammetry:

- (a) Analysis of the dimensional stability of negative and positive materials;
- (b) Analysis of present methods of Planimetric plotting and of transferring detail from photographs to base maps;
- (c) Determination of cost and available accuracy in topographic mapping by approximate and rigorous methods;
- (d) Development of new methods and equipment to most specific needs.

At its first meeting on April 22nd the Committee considered the program and divided the work among several sub-committees. These sub-committees worked out a series of projects to be conducted during the summer season of 1947. The preliminary reports on these projects are in the hands of the sub-committees and are being prepared for submission to the Main Committee.

AERIAL SURVEY RESEARCH—1948-49

Title	Participating Agencies	Budget
1. The Extension of the Work on Photographic Interpretation by J. R. G. Smyth and G. W. Rooney including: Variations in Scale, Filters, and Types of Terrain for Use in Forestry, Geology and Agriculture. (K. B. Jackson).	Photographic Survey Company; Dept. of Lands and Forests; Applied Physics, University of Toronto; Dept. of Mines; Eastman Kodak Company; The National Research Council.	\$
2. An Investigation of the Relative Merits and Costs of Transparencies and Paper Prints for Detailed Interpretation of the Photographs. (K. B. Jackson).		
3. An Investigation of the Dimensional Stability of Positive Printing Materials when used for Mapping. (K. B. Jackson).		
4. A Survey of Present Practices in Sensitometric Control and Preparation of Recommendations for Standard Specifications. (K. B. Jackson).		\$5,000.00

APPENDIX X.

SCHOLARSHIPS

Since the development and extension of research and, in consequence, of industrial progress in Ontario, is vitally dependent upon the availability of trained personnel, the Ontario Research Commission recognizes that the Province, the universities, the technical institutions, and the industries of the Province, individually and collectively, have significant roles to play in the training of persons who can give useful assistance in the research field.

The Commission is of the opinion that an important contribution to the carrying on of fundamental and applied research may be made by furthering the training of technicians in courses of the technical institute type extending over a period of one or two years at a level lying between that of the vocational high schools and that of the universities. The assistance of an adequate number of such persons would approximately double the effectiveness of the all too few fully qualified university graduate research workers.

The Commission desires to commend in general the longer and more advanced programs of educational training in industry as productive of persons valuable to research. It is to be hoped that industry may be able to extend this service.

The Commission realized that the need for trained personnel could not be met completely by the provision of scholarships. Nevertheless, to assist students with ability and as an adjunct to a complete program the provision of financial assistance to outstanding students plays a useful part.

As a result, during 1946-47 the Ontario Research Commission requested that \$20,000 be made available to provide scholarships for research students. Through recommendations from the Advisory Committees, ten scholarships were granted for work to be done during the 1946-47 term.

During the present year the Government provided a sum of \$50,000 for scholarships and \$44,275 has been spent in supporting 58 scholarships. 27 have been granted of a value of \$500, 25 of a value of \$900, and 6 of a value of \$1,200, and \$1,075 has been granted to provide travelling expenses.

The distribution among subjects is as follows:

Physics	22
Chemistry	8
Metallurgy	5
Forest Entomology	5
Limnology	4
Biology	3
Zoology	3
Physiology	3
Other subjects	5

The students are working in these universities:

University of Toronto	35
Queen's University	7
McMaster University	5
University of Western Ontario	4
Ontario Agricultural College	2
Yale University	1
Ohio State University	1
University of Michigan	1
University of Cambridge	1
University of Amsterdam	1

As a continuing policy it would seem to be desirable that there be some annual amount appropriated each year to provide scholarships. The amount might be a definite proportion of the annual research budget, say 10%.

APPENDIX XI.

PROVINCIAL RESEARCH EXPENDITURES

Research expenditures within the Province for the year 1947 are given below.

CAPITAL EXPENDITURES—ESTIMATED 1947

Department	Branch	Research	Development	Analysis and Testing
Agriculture	Ontario Veterinary College	7,800.00	10,300.00	4,000.00
Agriculture	Horticultural Experiment Station	125,000.00	—	—
Agriculture	Ontario Agricultural College	15,500.00	4,700.00	2,050.00
Agriculture	Experimental Farm, Ridgetown	—	—	—
Lands and Forests	Fish and Wildlife	3,500.00	50,000.00	3,500.00
Lands and Forests	Forestry	3,700.00	15,000.00	3,000.00
Mines	Geology	—	—	—
Highways	Soils and Research	2,000.00	3,000.00	10,000.00
Health	Public Health	—	2,100.00	—
		\$157,500.00	\$85,100.00	\$22,550.00

OPERATING EXPENDITURES—ESTIMATED 1947

Department	Branch	Research	Development	Analysis and Testing
Agriculture	Ontario Veterinary College	26,200.00	52,600.00	13,000.00
Agriculture	Horticultural Experiment Station	86,000.00	15,000.00	—
Agriculture	Ontario Agricultural College	198,732.00	34,204.00	105,221.00
Agriculture	Experimental Farm, Ridgetown	500.00	3,500.00	—
Lands and Forests	Fish and Wildlife	75,300.00	—	14,200.00
Lands and Forests	Forestry	69,200.00	48,500.00	12,300.00
Mines	Geology	9,500.00	288,000.00	—
Highways	Soils and Research	15,000.00	18,000.00	138,400.00
Health	Public Health	43,544.00	20,326.00	800,590.00
		\$523,976.00	\$480,130.00	\$1,083,711.00

Ontario Research Commission:	Research Grants.....	\$300,000.00
	Scholarships.....	50,000.00
	Administration.....	22,000.00

SUMMARY—RESEARCH EXPENDITURES—1947

Departmental.....	\$523,976.00
Ontario Research Commission.....	372,000.00

APPENDIX XII.

DEFINITIONS OF RESEARCH AND SCIENTIFIC ACTIVITY¹

Three major types of research work can be distinguished: (a) pure or fundamental research; (b) background research, and (c) applied or practical research.

Pure or Fundamental Research is defined as an investigation directed towards a discovery of previously unknown facts resulting in general knowledge and understanding of nature and its laws. The material application of the results of pure or fundamental research are not, of necessity, a basic consideration in undertaking this type of research but it forms the fundamental basis for all applied research and development work.

Background Research is defined as the collection and analysis of initial data for both pure and applied research. It consists of surveys and descriptions of basic facts such as the preparation of accurate geological maps, the determination of physical and chemical constants, the description of species of animals, plants, and minerals, the determination of standards such as those established for hormones, drugs, etc.

Applied or Practical Research is defined as an organized effort directed towards new applications of known scientific facts or principles to practical problems. As indicated previously, the distinction between fundamental and applied research is not always a hard and fast one and both contribute to progress in scientific knowledge. To give an instance, the study of the principles of electronics would be classed as pure research while the investigation of ways and means to use electronics in the home or factory would be applied research.

¹Research and Scientific Activity, Canadian Federal Expenditures—1938-1946. Pages 11 and 12.

APPENDIX XIII.

SUMMARY OF RECOMMENDED BUDGET EXPENDITURES—1948-49

	Capital	Operating	Total	
FISHERIES AND WILDLIFE COMMITTEE	\$	\$	\$	
McMaster University	5,037.00	20,165.00	25,202.00	
Queen's University	1,850.00	5,466.00	7,316.00	
University of Western Ontario	5,950.00	11,050.00	17,000.00	
University of Toronto	2,900.00	17,750.00	20,650.00	
Royal Ontario Museum of Zoology	1,500.00	14,850.00	16,350.00	
Ontario Research Foundation	2,775.00	24,200.00	26,975.00	113,493.00
FORESTRY COMMITTEE				
Queen's University	315.00	5,495.00	5,810.00	
University of Toronto	—	20,900.00	20,900.00	
Ontario Research Foundation	2,000.00	19,200.00	21,200.00	
Unclassified as yet	—	—	2,090.00	50,000.00
MINES, MINERALS AND METAL-LURGY COMMITTEE				
University of Toronto	6,020.00	10,047.00	16,067.00	
Queen's University	15,000.00	5,000.00	20,000.00	
Ontario Research Foundation	10,000.00	39,550.00	49,550.00	
McMaster University	—	—	5,000.00	90,617.00
INDUSTRIAL RESEARCH COMMITTEE				
Ontario Industrial Research Service	—	38,500.00	38,500.00	
Group Research	—	25,000.00	25,000.00	63,500.00
INDUSTRIAL WASTE COMMITTEE				
Department of Health	—	15,000.00	15,000.00	15,000.00
AGRICULTURAL COMMITTEE				
Ontario Research Foundation	2,000.00	18,000.00	20,000.00	20,000.00
SOILS COMMITTEE				
Ontario Research Foundation	1,300.00	22,425.00	23,725.00	23,725.00
AERIAL SURVEY COMMITTEE				
University of Toronto	—	—	5,000.00	5,000.00
SCHOLARSHIPS			50,000.00	50,000.00
ADMINISTRATIVE UNIT			25,000.00	25,000.00
				\$456,335.00

Date Due

JUL 20 1978

FORM 109



